



Policy Recommendations for Downstream Value Chain Development in the Mining Industry

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Abstract

This study aims to provide an overview of the current state and development of the heavy industry in Mongolia. The overview covers the four main resources in Mongolia - coal, iron ore, crude oil, and copper. Within the scope of the review, related development policies will be highlighted along with the current progress of major mining and processing projects. Additionally, the copper downstream industry is analyzed both within Mongolia and internationally. In doing so, challenges faced by the industries are highlighted, and policy recommendations are provided. To achieve this, developmental conditions for a downstream processing plant are considered, and a pre-feasibility model is constructed for a hypothetical copper wire manufacturing plant.

Key words: mining, downstream industry, project financing, feasibility, Mongolia

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1. Executive summary

For an economy heavily dependent on the mining sector such as Mongolia, the next step after exploration and extraction of mineral resources is the development of the downstream industry. The development of the downstream industry is crucial to further developing and adding value to the mining sector and diversifying the economy and its exports. Mongolia has been gradually building the foundations for the development of the downstream industry over the years. For the development of the downstream industry, several important conditions must be met, which can be more complicated for a developing country than development of the mining sector itself. These important conditions include but are not limited to:

- Availability of market demand for products,
- Available infrastructure and logistics,
- Human resource,
- Raw materials,
- Availability of financial resources,
- Favorable policy framework

From a policy standpoint, the conditions related to financial resource availability, human resource training, and export market have improved in recent years. However, as these conditions differ slightly from the conditions required for the mining sector, the related legislations and policies need to be upgraded and fine-tuned to also encompass the needs of the downstream industry.

In recent years, there has been a pronounced shift in the government's role in the development of large projects. The government has transitioned from being a passive player that only provides the policy environment for private investment to an active player that constructs infrastructure and industrial projects through government-owned resources rather than waiting for private companies to invest in these endeavors. Some of the shifts observed since 2018 are:

- Increased involvement of Erdenes Mongol LLC and Erdenet Mining Corporation as state-owned enterprises to finance and organize developmental projects
- Government established state-owned railway companies using the state-owned parent company Mongolian Railway (MTZ), which is not related to the existing Ulaanbaatar Railway (UBTZ)
- Erdenes Tavan Tolgoi JSC resources were utilized to finance construction of the Tavan Tolgoi-Zuunbayan and Tavan Tolgoi-Gashuunsukhait railway
- For the Tavan Tolgoi-Zuunbayan railway, construction brigades were formed within the Mongolian Army Forces and built the 400-kilometer railway within the span of two years
- The government also used foreign loan to finance the Dornogobi oil refinery
- The construction of the infrastructure for the oil refinery was financed by the Development Bank of Mongolia
- The Mongolian Stock Exchange became a source of financing for developmental projects with the issuance of the Erdenes Tavan Tolgoi bond
- Commercial banks actively participated in the construction of the Tavan Tolgoi railways through loan issuances

In 2007, Mongolia had not intended to actively manage its mineral holdings, but rather was planning to utilize foreign direct investment to reap the benefits from the development of the mining sector passively. However, since the establishment of the investment agreement with Rio Tinto for the Oyu Tolgoi project, Mongolia has begun to actively manage and expand its holdings of mineral licenses and use its resources for economic development through creation of joint stock corporate structures. Using the synergies created from the formation of these corporate structures, the country is now able to raise the necessary financing on its own and finance large projects within the downstream industry.

The study will provide an overview of the current state and development of the heavy industry in Mongolia, which includes the downstream industry. Within the scope of the overview, related developmental policies will be highlighted as well as the current progress of major mining and processing projects. The overview will cover the main mineral resources of Mongolia – coal, iron ore, crude oil, and copper.

Then, the study will focus of the downstream industry specifically related to copper. The copper downstream industry review will consist of international and domestic market and the demand and supply in the respective markets. Additionally, international and domestic case studies and the current and ongoing infrastructure projects which impact the copper downstream industry will be briefly examined.

The main objective of this study is to highlight the challenges faced by the industry and provide some guidance on the policies that are needed to help develop the industry. To achieve this, financing possibilities for the construction of a downstream plant and factory are assessed and a pre-feasibility model is constructed for a hypothetical copper wire manufacturing plant. The pre-feasibility model will be used to highlight some of the key operating costs and risks associated with the manufacturing of copper products. The main outputs of the study will be identification of challenges and present policy recommendations for the development of the downstream industry.

2. Heavy industry current state and development

Mongolia's economic growth rate was already starting to decline prior to the COVID-19 outbreak in late 2019. In the fourth quarter of 2019, the economy only grew by 0.9 percent year-on-year due to a 16.2 percent decline in mining sector production. The decrease in production was attributable to a number of external and domestic factors such as increased global uncertainties, trade war between China and the United States, decrease in global commodity prices, quota imposed by China on imported coal, and bottlenecks at the border crossing.

Then, when the global pandemic occurred and most economies and trades were adversely affected, a majority of the planned industrial projects were put on hold. For more detail on the impact on the COVID-19 pandemic on the Mongolian economy, please refer to the "COVID-19 Impact on Mining" study (ERI, 2021b).

In terms of institutional and business environment, Mongolia does not score as well as its East Asia and Pacific counterparts. According to the World Bank's Doing Business report, Mongolia score 67.8 out of 100 in 2020 for ease of doing business, ranking 81st, downgrade of 7 places from 2019. Although Mongolia made some progress in resolving insolvency, other countries showed more improvement in their business environment. Instability of economic policies and regulations, geographical isolation, corruption, and inefficient transportation systems continue to be significant obstacles faced by Mongolia.

Table 1. Doing Business, Mongolia and East Asia and Pacific region, 2016-2020

	Ease of doing business (0-100)		Corruption perceptions index (0-100)	
	Mongolia	EAP Average	Mongolia	EAP Average
2016	65.3	61.5	38	44
2017	66.1	62.0	36	44
2018	67.4	62.7	37	44
2019	67.7	63.4	35	45
2020	67.8	63.3	35	45

Source: World Bank, Transparency International

On the Corruption Perception Index, Mongolia's score has been steadily improving since 2016. Although the perceived level of corruption is declining, Mongolia's rank within the index worsened from 106th in 2019 to 111st in 2020. Even though indicators such as democracy and competitiveness have improved in Mongolia, Mongolia still has long ways to go to eradicating corruption. Removal from the Financial Action Task Force's greylist and improvements in credit ratings are positive progress in improving the business environment of Mongolia.

The macroeconomic and business environments have a significant impact on the implementation of large projects. During economic downturns or unstable business and investment environment, it may be more difficult to secure financing to commence certain projects due to the inherent risk associated with new projects and uncertainties. In addition to these factors, the legislative and regulatory environment is equally crucial to the development of the heavy industry. The

development of the heavy industry is important for the further development of the mining sector and diversification of the economy. Therefore, in this section, the current policies related to the heavy industry and current and ongoing mining and processing projects shall be reviewed.

2.1. Policies

Support from the government in the form of policies are necessary for sustainable economic growth, development of the heavy industry, production of value-added products, and diversification of exports. In order to strengthen the development policy, the Parliament of Mongolia approved the “Law on Development Policy and Planning” on 26 November 2015 to ensure sustainability and consistency of development policy making and planning process; regulate development, adoption, planning, implementation, monitoring and evaluation, and reporting of the developmental policies; and establish an integrated system of developmental policy, planning, and management.

In addition to this, the “Mongolian Sustainable Development Vision 2030” was adopted on 5 February 2016 with four pillars: economic, social, environmental, and governance. These two policies were followed by a number of policy documents and development plans.

The government established the Ministry of Industry in 2014, which was later split so that the Ministry of Mining combined with heavy industry in 2016 and the Ministry of Agriculture with the light industry. The Department of Heavy Industry Policy has existed since the Ministry of Industry and was relocated to the Ministry of Mining and Heavy Industry when the two merged. The main purpose of the Department of Heavy Industry Policy is to improve the sector’s policies and legal environment. The Department currently oversees the implementation of large industrial projects excluding crude oil.

It is expected that Ministry of Economic Development (MED) will be created to oversee and coordinate the large industrial projects in the future. The currently being planned projects are steel and copper refinery. The MED will likely retain most of functions, which the National Development Agency (NDA) has now, including granting of stability agreements to investors and rights to concessions agreements. Additionally, MED will be more powerful in terms of being able to allocate resources.

2016-2020

The Government Action Plan for 2016-2020 stated that the government will aim to create a favorable investment environment for geology and mining, ensure sustainable development of the mining sector, and enhance the competitiveness of Mongolia on the international minerals market. Some relevant provisions from the action plan were:

- 2.65. Formulate a long-term mining infrastructure development planning and improve coherence among sectors.
- 2.67. Create a legal environment to utilize secondary mineral resources and bring the process of mine rehabilitation and the closure to international standards.
- 2.70. Steadily increase oil extraction and construct an oil refinery.
- 2.71. Support the construction of copper concentrate smelter and refinery.

- 2.72. Establish the conditions necessary to construct a metallurgical complex in the Darkhan and Selenge regions.
- 2.73. Render policy support to setting up a coal washing and deep processing plant and coal gas extracting plant.
- 2.74. Render policy support to setting up a plant for liquified fuels and lubricants.

The main outputs of these policies were the commencement of the oil refinery project in Dornogobi province, some changes in mining policies and related taxation, and commencement of the 2 railway routes through the Gobi Desert.

2020-2024

Subsequently, the government approved the Government Action Plan for 2020-2024 in 2020, based on Mongolia's long-term development policy "Vision 2050," which was adopted in May 2020. The unfulfilled goals from the Government Action Plan for 2016-2020 were reflected again in the new action plan, namely the metallurgy goals, while some of the goals were being implemented. Provision 3.2 of the Government Action Plan for 2020-2024 states that the government will create a sustainable and multi-pillar economic structure and implement the principle of fair distribution of wealth by developing transparent and responsible mining and value-added industry and ensuring the growth of mineral revenues. In addition, the construction of heavy industries, such as oil, coal-chemical, copper concentrate, and metallurgy will commence, and related infrastructure projects will be implemented.

Between 2016-2020, the railway and oil refinery projects had begun; therefore, the goals for 2020-2024 shifted to metallurgy and coal processing. In metallurgy, the main focus was on ferrous metals (iron and steel) and non-ferrous metals (gold and copper).

The main provisions related to the development of the heavy industry in the Government Action Plan for 2020-2024 are:

- 3.2.7.1. Develop ferrous metallurgy (coke, cast iron, direct reduced iron) in Darkhan-Uul, Orkhon, and Dornogobi provinces.
- 3.2.7.2. Establish an industrial and technological park within Erdenet Mining Corporation. The park will include a copper concentrate processing plant and a cathode copper plant with heap leaching technology of oxidized ore. (As can be seen, the general consensus was the shift of location to Erdenet)
- 3.2.7.3. Build a precious metals refinery plant (gold refinery)
- 3.2.7.5. Commence the construction of copper concentrate processing plant at the Oyu Tolgoi mine.

The plan also includes measures to intensify oil exploration and construct an oil refinery was continued from the previous plan in the Government Action Plan for 2020-2024, thus continuing the efforts to strengthen the rising petrochemical sector. In addition to these provisions, the government stated it will establish a system of equitable and fair distribution of benefits of mining to every citizen through the wealth fund.

2020-2050

Mongolia's long-term development goals are now encompassed in "Vision 2050," which was approved by the Parliament in May 2020. The approval of this document rendered "Mongolia's Sustainable Development Vision 2030" ineffective and served as its replacement.

The Vision 2050 has nine core goals and fifty objectives, to be carried out in the next three decades: 2020-2030, 2031-2040, and 2041-2050. Following the long-term vision, the national mid-term development strategy was articulated in the "General Guidelines for Medium-Term Development (2020-2025)" and the Government Action Plan for 2020-2024.

Objective 4.2 of the Vision 2050 is to create an export-oriented economy by promoting the development of priority sectors. Within the scope of this objective, the issues and challenges related to value-added mining, strategic mega-projects, manufacturing development, and infrastructure will be addressed. An overview of the objectives related to mining and heavy industry development outlined in the document are below:

- 4.2.11. Develop the mining sector into a responsible economic sector that is environmentally friendly.
- 4.2.12. Adhere strictly to international standards and norms when putting large mineral deposits into economic circulation.
- 4.2.13. Develop an environmentally friendly and sustainable heavy industry with value-added processing of raw mineral commodities and support advancement of the various forms of investment.
- 4.2.14. Put mining deposits into economic circulation and construct heavy industry industrial complexes.
- 4.2.16. Construct an oil refinery plant and related infrastructure networks and a petrochemical plant.

Vision 2050 reiterates focus on following deposits and complexes to be constructed under Objective 4.2.14 but reflects changes in domestic industry, as oil refinery is slated to become a foundation for petrochemical industry and further shows the focus on metallurgy and newly added rare earth related to growth of world green economy:

- Mining deposits:
 - Tavan Tolgoi coal deposit
 - Oyu Tolgoi underground mine
 - Dornogobi silicon deposit
 - Tsagaan Suvarga deposit
 - Kharmagtain deposit
 - Lithium deposit
 - Step up exploration and survey work of rare earth elements.
- Heavy industry:
 - Copper concentrate processing plant
 - Oil-chemical, coke-chemical, metallurgical plants
 - Coal-washing plant
 - Coal-chemical, coal-energy, and methane gas production and technological park
 - Steel factory

- Fluorspar enrichment plant
- Gold refinery plant.

The government also plans to implement “100+ projects” to revitalize the economy post-COVID-19. The list includes 50 economic projects, 25 social development projects, and 25 governance reforms. These projects are long-term projects, some of which are already included within the government action program. However, the 100+ project does not include a precious metals refinery plant (gold refinery) and a copper concentrate processing plant at Oyu Tolgoi, both of which was included in the Government Action Plan for 2020-2024.

Mongolia’s short-, medium-, and long-term development plans all clearly state the need to diversify the economy and support the development of the manufacturing and processing sector. It also sets ambitious goals for the production of value-added mineral products and processing of raw mineral commodities. This highlights the strong continuing support from the Government of Mongolia for the mining-based processing industry at the policy level and its willingness to further develop the industry.

2.2. Current geological exploration and findings

As of March 2021, Mongolian reserve of copper, coal and iron ore was 61 million tons, 40 billion tons, and 1860 million tons, respectively. As for crude oil reserves, there are 332.6 million tons with 43.3 million tons proven. According to the Mineral Resource and Petroleum Authority of Mongolia, as of 2020, there are 1,696 mining licenses and 976 exploration licenses for a total of 2,672 registered licenses across 6,247.2 thousand hectares of land in Mongolia.

The total number of licenses decreased by 25 percent between 2016 and 2020, and the share of the total covered territory halved. This is directly related to the decrease in the number of exploration licenses. In terms of mineral resource, licenses for coal and gold account for a significant portion of the licenses in Mongolia. Moreover, as of 2020, 26 percent of the mineral licenses were granted for gold, 18 percent coal, 5 percent iron, and 1 percent copper.

Figure 1. Number of mineral licenses, 2016-2020

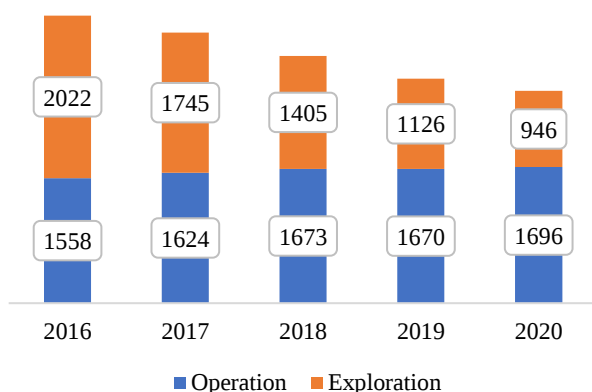
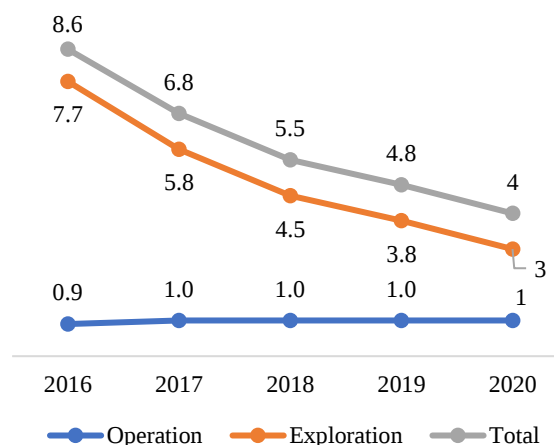


Figure 2. Percentage of the total territory of licensed areas, 2016-2020



Source: Mineral Resources and Petroleum Agency of Mongolia (MRPAM),

Basic geological surveys included in the State Policy on Mineral Resources and the Government Action Plan for 2016-2020 were carried out in 2016, 2017, and 2019 with funding of MNT 9.3 billion, MNT 13.1 billion, and MNT 23.8 billion, respectively (EITI, 2020).

The table below shows the cost of private investment and publicly funded geological exploration.

Table 2. Geological exploration cost, million MNT

Type of activities	2016	2017	2018	2019
State-funded	9,341.1	12,255.1	13,335.0	24,621.0
Private investment	190,260.4	130,586.6	148,775.5	140,572.3
Total	199,601.5	142,841.7	162,110.5	165,193.3

Source: EITI and MRPAM

Geological exploration costs have declined in recent years. For instance, exploration cost in 2019 decreased by 17 percent compared to 2016 due to a reduction in the cost of exploration with private investment. Between 2016 and 2019, state-funded exploration expenditures grew 2.6-fold.

The GOM has recently undertaken a number of measures to accelerate exploration:

- Significantly expanded state-financed exploration from MNT 9.3 billion in 2016 to MNT 24 billion in 2019.
- Included oil exploration in the Refinery Act (passed in 2021) to actively search for more sources of oil.
- The National Geological Survey was established in 2020. This new agency, in charge of explorations, will be an implementing agency under the Ministry of Mining and Heavy Industry, consisting of the Exploration Department (formerly at MRPAM), Minerals Information Technology Center, Geological Research Center, and Central Laboratory of Geology. The new agency is working in collaboration with MUST and NUM in geology

training and have trained experts from Russia, Japan, South Korea, and Germany. The agency was established with some assistance from the Australia Aid and the Adam Smith International Consultancy.

It is expected that the ratio of exploration licenses to overall licenses will increase as a result of these measures. Currently, the share of exploration license is very low, illustrating a lack of exploration activities.

2.3. Current projects

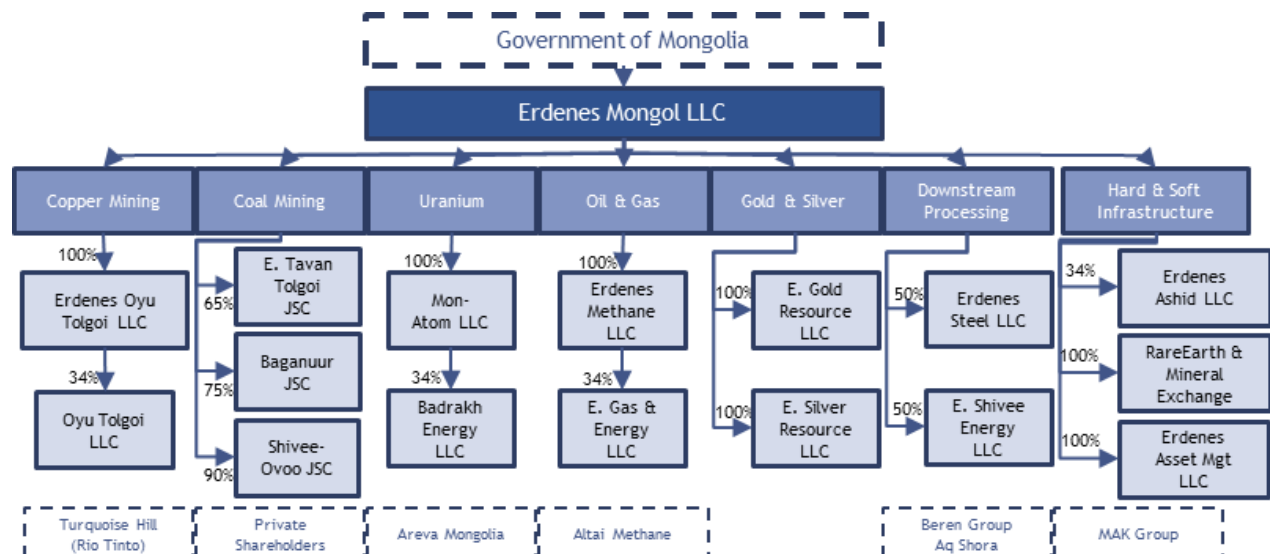
The following sections provide a detailed look at major mining and processing projects, which are currently operational or will soon be.

2.3.1. Erdenes Mongol LLC

Erdenes Mongol LLC (EMGL) is a state-owned enterprise established in February 2007 in order to manage Mongolia's strategically important mineral deposits. The first four entities fully or partially owned were all mining projects: Oyu Tolgoi (copper), Tavan Tolgoi (coal), Baganuur (coal) and Shivee Ovoo (coal). Oyu Tolgoi is 34% owned by EMGL and 66% owned by Turquoise Hill Resources, which is majority-held by Anglo-Australian conglomerate Rio Tinto. In recent years, EMGL has expanded its portfolio, covering a wide variety of sectors, including Uranium (Badrakh Energy with French Areva), Oil & Gas (Erdenes Gas & Energy with local Altai), Downstream Processing (Shivee Energy with Chinese State Grid and Erdenes Steel with local Beren), Infrastructure (Erdenes Ashid with local MAK), Gold and Silver Mining, and Asset Management (Erdenes AM to attract foreign investment in Mongolia).

The medium-term strategic plan for 2019-2023 focuses not only on coal, copper, gold, and silver production but also on energy and infrastructure development. The following figure shows the structure of EMGL.

Figure 3. Erdenes Mongol LLC structure



Source: Annual report 2018

As seen in the figure above, Erdenes Steel and Erdenes Shivee Energy are operating in the downstream processing industry.

Erdenes Gold Resource LLC

Erdenes Gold Resource LLC was established in 2018 as a subsidiary of EMGL. The company mines, refines, and sells precious metal in the territory of Mongolia within the scope of the Government of Mongolia's "Gold-2" program. Erdenes Gold Resource LLC is planning to build the first national gold refinery plant in Mongolia. The planned gold refinery will be built in Ulaanbaatar's Songinokhairkhan district. The gold refinery is expected to increase Mongolia's treasury funds and stabilize the national currency in the future.

Erdenes Silver Resource LLC

Erdenes Silver Resource was established in 2019 by Resolution No. 133 of the Government of Mongolia in 2014 and Resolution No. 15 of the Board of Directors of "Erdenes Mongol" LLC in 2019. Erdenes Silver operates in the following areas:

- Consulting service
- Mineral exploration
- Extraction and production of minerals
- Contract drilling service

As part of the government's policy on the mining sector, the government and the Mineral Resource and Petroleum Authority granted Erdenes Silver a 2887.85-hectare mineral exploration license in Salkhit. Erdenes Silver holds licenses for the Asgat silver deposit (6,400 tons of silver) and the Salkhit silver deposit (982 tons of silver and 1.3 tons of gold). The Ministry of Mining and Heavy Industry has licensed these deposits to Erdenes Silver Resource in order to create new sustainable source of revenue for the state budget.

EMGL's other subsidiaries are discussed in the following sections. The relevant project and company are discussed in the respective subsections consisting of mineral resources.

2.3.2. Coal projects

The Mongolian Ministry of Mining and Heavy Industry and the Mineral Resource and Petroleum Authority are the main regulators of the Mongolian coal market. The largest companies in the Mongolian coal market are Erdenes Tavan Tolgoi, SouthGobi Sands, Mongolyn Alt, Erdenes Tavan Tolgoi and Energy Resources. As of March 2021, Mongolia's coal reserves was 40 billion tons.

Erdenes Tavan Tolgoi

Erdenes Tavan Tolgoi JSC (ETT) is the largest coal miner in Mongolia. ETT was established in 2010 and operates in accordance with the "Minerals Law" in the main areas of putting strategically important coal deposits into economic circulation, operating mining operations, and implementing

infrastructure projects. Parliament Resolution No. 73 of 2018 outlines some of the measures to be taken to intensify operations at the Tavan Tolgoi coal deposit. The resolution calls for a road and railway project from the Tavan Tolgoi coal mine to the border, a power plant to meet the energy needs of the mining projects in the southern region, and the construction of a coal chemical plant. Some of these projects are currently underway with financing from the recent ETT bond issuance.

Tavan Tolgoi CHP plant is mainly financed by the Government of Mongolia. Capacity of the plant is 450Mbt and the total required investment is USD 600 million. In 2018, the Government of Mongolia signed an agreement with Oyu Tolgoi to build a power plant. Oyu Tolgoi's power plant project is estimated to cost a total of USD 1.1 billion. However, the Government of Mongolia decided to build the power plant with its own funding, as Oyu Tolgoi's estimation would cost 2-3 times more than the international average. Tavan Tolgoi CHP plant is owned by The Ministry of Energy (50 percent), ETT (30 percent), and Government Agency for Policy Coordination on State Property (20 percent). Construction of the CHP plant is expected to commence in the second quarter of 2021 and be completed by 2024. The plant's annual consumption of thermal coal will be 1.4 Mt. The commissioning of this power plant could save around USD 200 million in annual electricity costs. The main users of the new power plant will be the Tavan Tolgoi coal mine complex and Oyu Tolgoi LLC.

ETT Coal concentrator: Within the framework of Parliament Resolution No. 39 of 2010, Government Resolution No. 214 of 2019, and the “National Program for the Development of Heavy Industry”, the Coal Concentrator with modern advanced technology will be developed by mixing low quality coking coal with high quality coal. The coal concentrator is planned to be commissioned in the first quarter of 2024 and will process 10 Mt of coal per year in the first two years of operation and 30 Mt in the third year, its maximum capacity. The plant plans to sell and export 12 Mt of solid coking concentrate, 5.5 Mt of intermediate products for energy use, and a total of 17.5 Mt of concentrate in 2021-2025. In addition, the plant's products will supply raw materials for the Tavan Tolgoi CHP plant. The total cost of the project is USD 911.53 million and the return on investment is expected to be high within 7 years. The plant was not built in 2020 due to the COVID-19 pandemic, but it is expected that its construction will start in 2021.

ETT Coke-Energy Plant: One of the planned coal processing projects by ETT is the Coke-Energy Plant. The plant will produce four types of coke products and accompanying energy, and supply value-added products to the market. Additionally, processing of coal will expand the export target market and enable the export of metallurgical coke and enriched coal to markets such as Japan, South Korea, and remote provinces of China.

Erdenes Shivee Energy LLC: Shivee Energy Complex Project

Erdenes Shivee Energy LLC, a subsidiary of EMGL, was established in 2016. Erdenes Shivee Energy will supply coal to the Shivee Energy Complex Project, which will be based on the strategically important Shivee-Ovoo coal deposit with 1.2 billion tons of coal reserves. 50 percent of the company is owned by the state-owned EMGL and the remaining 50 percent by the private company Eikusora LLC. The planned Shivee Energy Complex Project will have an annual capacity of 5,280 MW and use about 20 million tons of coal per year. The Shivee Energy Complex is expected to be located in the Shiveegobi soum of the Govisumber province. The power plant is

expected to supply energy to both domestic and Chinese markets as well as Northeast Asia. Some of the specifications of the projects are:

- Coal mining capacity - 20 million tons / year /
- Power plant capacity - 5280 MW
- Renewable power plant capacity - 15% / power plant /
- Ultra-high voltage transmission line - 4600 MW $\pm$ 660 kV

Mongolyn Alt LLC

“Mongolyn Alt” (MAK) LLC is one of the largest mining and exporting companies in Mongolia. MAK began exploration of the Nariin Sukhait deposit in 2002-2006 and started mining in 2007. The Nariin Sukhait mine is located in Dalanjargalan soum of Umnugovi province, and has a production capacity of 10 million tons of coal per year. MAK has implemented a concentrator project to fully utilize the resources of the Nariin Sukhait mine and to produce value-added products. The plant has the capacity to process 1 million tons of coal per year.

2.3.3. Iron ore projects

The Mongolian Ministry of Mining and Heavy Industry and the Mineral Resource and Petroleum Authority are the regulators of the Mongolian iron market. As of March 2021, Mongolia’s iron ore reserves were 1860 million tons. The largest companies in the Mongolian iron ore market are Boldtumur Eruu Gol LLC, Darkhan Metallurgical Plant JSC, Mongolrostsevetmet LLC, and Altain Khuder LLC. The following section discusses Mongolia's iron ore processing projects.

EMGL: Erdenes Steel LLC: One of Mongolia’s iron ore processing projects is Erdenes Steel LLC located in Choir soum of Gobi-Sumber province. Erdenes Steel LLC was established in 2017 and is owned by Beren LLC (50 percent) and EMGL (50 percent). The project aims to substitute about USD 250 million imports and produce value added products to be consumed domestically. In April 2019, the Mongolian Mineral's Council approved the feasibility study of the project. When the project is commissioned, Erdenes Steel will be able to produce around 500 thousand tons of coke and 300 thousand tons of steel castings. A total investment of MNT 320 million is required to establish coke and steel plant complex (AsiaMining, 2019). The complex is expected to utilize coking coal from Tavan Tolgoi and Mogoin Gol, as well as iron ore and concentrate from a group of deposits near Bayangol, Bargilt, and Choir.

Beren Group

Beren Steel, a subsidiary of Beren Group, built a direct reduced iron (DRI) plant in Erdenet in 2014. The plant produces 35 thousand tons of pig iron per annum. Currently, Beren plans to build steel plant with the ability to produce 100 thousand tons of reinforcing. The project is expected to be located near Khukh Gan JSC and the “Mining, Metallurgy, Chemical Industrial Complex” in Erdenet. The plant will meet a third of domestic demand for steel and reduce import dependence. Currently, Mongolia's annual demand for steel and iron products is about 300,000 tons and more than 80 percent of it is imported from China.

2.3.4. Crude-oil projects

Mongol Refinery state-owned LLC

As of March 2021, Mongolia's extracted oil reserves are 332.6 million tons and proven reserves are 43.3 million tons. In 2017, the Government of Mongolia initiated the “Mongol Refinery” project in Altanshiree soum at Dornogobi province. The project aims to establish a petroleum refinery and petrochemical plants to refine domestically extracted crude oil. The infrastructure construction work started in 2018 with USD 1 billion soft loan from the Government of India. Construction of the external infrastructures began in October 2019.

The umbrella agreement on Indian development loan was signed in April 2016, the oil refinery project was approved by a Cabinet decision No 59 in 2017 with a project capacity of 1.5 million tons. The feasibility study was completed by Indian “Engineers India Ltd” company in 2018, approved by Ministry of Mining and Heavy Industry in November 2018.

In 2019 the plant's infrastructure construction of 27 kilometers of railway line, 17.5 kilometers of road and 19 kilometers of power transmission line to connect the refinery was commissioned and India has announced an additional 236 million U.S. dollars line of credit from India to Mongolia beyond the committed 1 billion U.S. dollars and the Engineers India Limited, a public sector undertaking of the Ministry of Petroleum and Natural Gas of India, is providing project management consultancy services for this refinery project. The external infrastructure work was completed in 2021 and the engineering team from India arrived on the site in Spring 2021 to commence the plant construction. The project was delayed by 1.5 years due to COVID-related lockdowns imposed in first quarter of 2020.

The construction of the internal infrastructure of the refinery officially began in January 2021. The plant's infrastructure will be built by the company “JMC Project India”. According to preliminary estimates, 1,000 engineers, technicians, and assistants will be employed during the construction work in 2021, 5,000 in 2022, 8,000 in 2023 and 7,000 in 2024. Currently, 14 engineers and technicians have arrived from India and an additional 45 engineers and technicians will arrive later. The project will complete 12 buildings and dams and 80 km of roads within 26 months or by 2024. The plant was scheduled to be commissioned in 2023, but was delayed until 2024 due to the COVID-19 related lockdowns. Mongol Refinery plans to build a crude oil pipeline with the capacity to process 1.5 million tons of oil per year in line with the 2010 oil development plan (Montsame, 2021). With the commission of this project, Mongol refinery will be able to produce 43 thousand tons of liquefied petroleum gas, 339 thousand tons of gasoline, 824 thousand tons of diesel fuel, 80 thousand tons of jet fuel, and 47 thousand tons of stove fuel, which is will meet three-quarters of Mongolia's oil demand (Mongol Refinery, 2019).

In 2021 a special law to support the project was passed by Parliament on 29th of January 2021. The approved law creates legal foundation for actions and activities related to the oil refinery under construction in Dornogobi Province as well as its facilities and infrastructures, including the usage of international norms, standards and regulations, control, facilitation and approval of the oil refinery's blueprint and designs and commissioning of the factory and the establishment of a product sharing agreement on the oil field and ensuring of stable supply of raw products, reports the Ministry of Mining and Heavy Industry.

The law contains 3 policy measures to support the downstream processing plant project:

1. The documentation development and adoption of the international standards, related with the processing, operations, and maintenance of the refinery
2. Support construction of the plant and related infrastructure, support oil exploration and securing sources of raw materials
3. Fast track of import of related machinery, speedy entry of foreign personnel and fast customs passage of raw materials and parts.

On completion of the project in 2023/2024 (the original date was 2022), the refinery will have a processing capacity of 1.5 million metric tons of oil per year and will annually produce 560,000 tons of gasoline and 670,000 tons of diesel fuel, as well as 107,000 tons of liquefied gas, fuel oil and jet fuel being produced as secondary products. The refinery would boost Mongolia's gross domestic product by 10 percent. As of 2018, Mongolia produced 7.6 million barrels of oil or about 21,000 bpd, amounting to 6 percent of its total export earnings.

2.3.5. Copper projects

As of March 2021, Mongolia's copper reserves were 61 million tons. Most of the copper reserves are located at the Erdenet Ovoo deposit, the Kharmagtai deposit, and the Oyu Tolgoi deposit. Oyu Tolgoi and Erdenet Mining Corporation are the main copper concentrate suppliers in Mongolia.

Oyu Tolgoi: Oyu Tolgoi is one of the world's largest copper-gold mines and is located in the southern Gobi region of Mongolia. Oyu Tolgoi was a joint venture by Erdenes Oyu Tolgoi (34%), owned by the Government of Mongolia, and Turquoise Hill Resource (66%), a Canadian-based international mining company focused on copper-gold and coal mines in Mongolia. Rio Tinto (a leading international mining group and a London listed public company) owns a 50.8 percent stake in Turquoise Hill Resource. Oyu Tolgoi mined 693.1 thousand tons of copper concentrate and produced 149.6 thousand tons of copper in 2020. With the commissioning of the underground mine, Oyu Tolgoi will be able to produce 480 thousand tons of copper (stated as recovered metal) annually from the open pit and underground mines between 2028 and 2036 (Rio Tinto, 2020).

Erdenet Mining Corporation: One of the largest state-owned mining companies is Erdenet Mining Corporation (EMC). EMC was established in accordance with the agreement between the governments of Mongolia and the (former) Soviet Union. It began operations in 1978. The Mongolian Copper Corporation (MCC) purchased 49 percent of Erdenet mine from the government of Russia in 2016 and now, the mine is currently 100 percent Mongolian owned. The company extracted 582.6 thousand tons of copper concentrate in 2020. EMC plans to establish a metallurgy-chemical plant complex, including a factory for smelting and processing copper concentrate, processing low-grade copper ore, using SX-EW technology, processing oxidized ore, and manufacturing sulfuric acid and emulsion explosion. At a Cabinet meeting in May 2021, EMC was granted a license to operate a metallurgy-chemical plant complex. A total investment of MNT 1.8 trillion is required to establish the metallurgy-chemical plant complex. The planned copper smelting plant, which is part of the complex, will produce 125.5 thousand tons of copper cathode, 72 kg of pure gold, 38 thousand kg of pure silver and elemental sulfur and sulfuric acid per year. With the commissioning of this complex, the "Erdenetiin Ovoo" strategic deposit will be fully utilized and put into economic circulation and the factory will be developed as a cluster based on

modern technology. As a result, Mongolia will be able to produce value-added refined copper and export to the international market. It will lead to more opportunities in the mining and industrial sector and have significant positive impact on economic growth.

3. Copper downstream industry

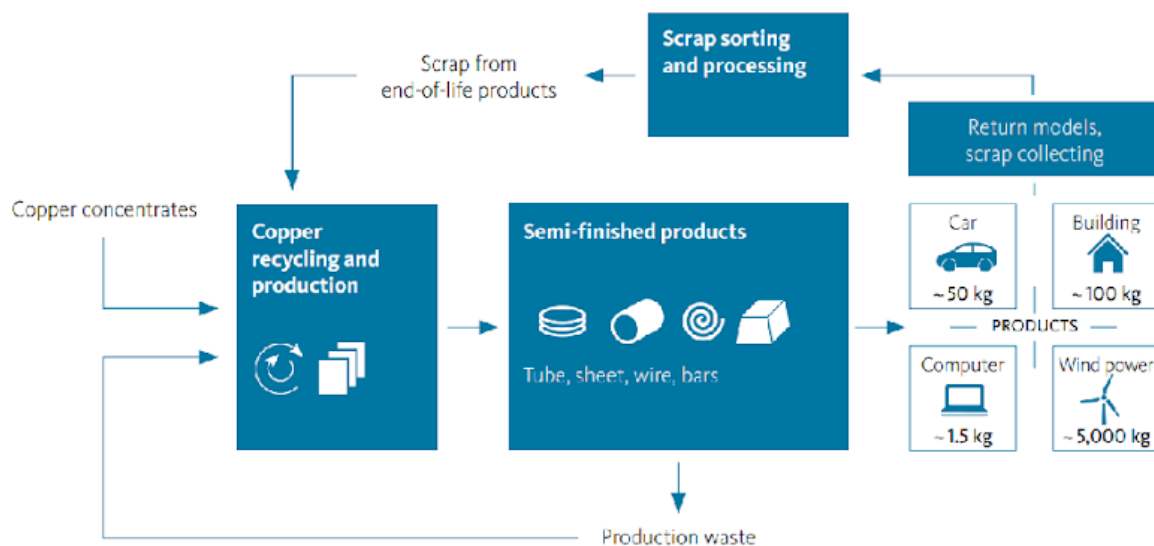
Mongolia is very rich in copper and has potential to become one of leading world suppliers of copper concentrate in future. Therefore, this section of the report specifically concentrates on the copper market and its downstream products.

Copper concentrate is commonly pyrometallurgical processed to the metal form. The main steps involved in this process is extraction, comminution, roasting, and smelting. Copper anodes resulting from smelting are then electrolytically refined to increase the grade of copper cathodes. Hydrometallurgy bypasses smelting and involves leaching and solvent extraction followed by electrowinning.

Copper cathodes are then wrought to produce semi-finished products such as copper bars, rods, wires, plates, sheets, tubes, pipes, powder, and flakes. Part of the refined copper is remelted for adding alloying elements and obtaining alloys such as brasses and bronzes.

The semi-finished copper products are incorporated into finished products. The main end-uses of copper include *electrical and electronic products* (e.g., power utilities, telecommunications, lighting, and wiring devices), *building and construction* (e.g., plumbing and heating, building wire, air conditioning, and commercial refrigerator), *industrial machinery and equipment* (e.g., in-plant equipment, industrial valves and fittings), *transportation equipment* (e.g., automobile, truck and buses, railroad, marine and aerospace), *consumer and general goods* (e.g., appliances, cord sets and consumer electronics).

Figure 4. Copper value chain

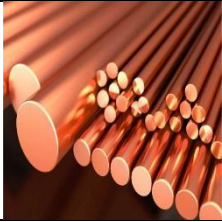
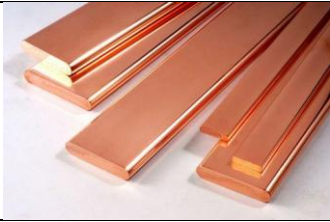


Global copper mine production in 2019 reached 20.5 million tons. The largest producer of mined copper was Chile (5.8 million tons), while the refined copper usage (usage by semis plants or the first users of copper) in 2019 reached 24.4 million tons. China was also the largest consumer of refined copper in 2019 with apparent usage of around 12.7 million tons (ICSG, 2020). Smelter

production in 2019 reached around 20.0 million tons. China was the largest producer of blister & anode in 2019. According to the International Copper Association (ICA), equipment was the largest copper end-use sector in 2019, followed by building construction and infrastructure.

Finished and semi-finished copper products come in various forms. Below is a table describing the various product forms.

Product	Description	Example
Bar	A solid rectangular section, or one with two plane parallel surfaces and round or other simple regularly shaped edges, up to and including 12 inches in width and over 0.188 inches in thickness	
Billet	A solid cylindrical casting used for hot extrusion into rod, bar, tube, or shape or for hot piercing into tube	
Extrusion	Stock brought to final dimensions by extrusion	
Extrusion, hot	The process of shaping metal into a chosen continuous form by forcing it from a closed container through a die of appropriate shape	
Foil	A term often applied to a thin flat rolled section usually 0.005 inches or less in thickness	
Hammer forging	A forging process in which the piece is deformed by repeated blows	
Hot press forging	A method of forming parts by pressing a heated slug or blank cut from wrought material in a closed impression die	
Pipe	Seamless tube conforming to the particular dimensions commercially known as Standard Pipe Sizes	
Plate	A flat rolled product over 0.188 inches in thickness and over 12 inches in width	

Rod	A round, hexagonal or octagonal solid section furnished in straight lengths	
Shape	A solid section other than rectangular, square, or standard rod and wire sections, furnished in straight lengths	
Sheet	A flat rolled product up to and including 0.188 inches in thickness and over 20 inches in width	
Slab	A casting in the form of a bar used for rolling into strip	
Strip	A flat product, other than flat wire, up to and including 0.188 inches in thickness and generally furnished as: • With slit, sheared or slit and edge rolled edges in widths up to 20 inches inclusive • With finished drawn or rolled edges in widths over 1.25 inches to 12 inches inclusive	
Tube	A hollow product or round or any other cross-section, having a continuous periphery	
Wire	A solid section, other than strip, furnished in coils or on spools, reels, or bucks. Flat wire including square, however, may also be furnished in straight lengths	

Of the various forms of copper products, the most semi-finished product that is most produced and demanded is copper wires. Around 75% of semi-finished production and demand is copper wires according to the International Wrought Copper Council. This trend has not changed since 2012. If around 14.5 Mt of copper wire was produced in 2012, by 2019, over 17 Mt of copper wire was produced.

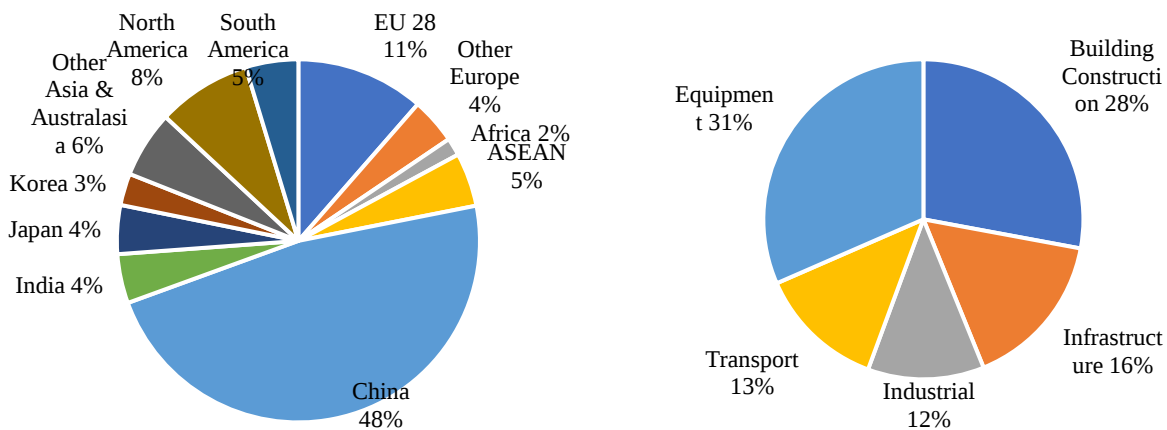
3.1. International copper downstream market

Demand and production composition of semi-finished copper products have not changed over the past decade; however, the volumes have increased by around 20 percent. The leading importer of semi-fabricated copper products is China, followed by the United States, India, Italy, United Kingdom, and Germany. As for exporters, Germany exported over 800 thousand tons in 2019 whereas China exported around half the amount.

3.1.1. Demand

Although copper consumption is more geographically distributed than most metals, China remains the dominant market. Of total copper downstream demand, around 70 percent is from Asia, 15 percent from Europe, 13 percent from the Americas, and 1.6 percent from the rest of the world. As mentioned previously, the main end-use sectors are building construction, equipment, infrastructure, industrial and transport. Copper wiring and plumbing are integral to appliances, heating and cooling systems, and telecommunications. It is also an essential component in motors, wiring, radiators, connectors, brakes, and bearing used in cars and trucks.

Figure 5. Copper usage by region and end-use sector, 2019



Source: International Wrought Copper Council

Copper demand is expected to grow in renewable electricity generation, the construction sector, and electric vehicles in the coming years. As countries commit to cutting down carbon emissions and focus more on renewable energies, the demand for copper is expected to rise as more investments are poured into clean technology and energy storage. Copper's unique properties for conductivity and energy efficiency means that it will continue to be crucial as the world adopts more sustainable practices. Renewables generally use much larger volumes of copper than thermal electricity generation, which releases a lot of conventional greenhouse gas.

Another side effect of the global transition to net-zero gas emissions is the increase in sale of electric vehicles. The use of electric vehicles is likely to increase even further in the future due to technological advancements which increase vehicle performance and reduce battery costs.

Type of vehicle	Amount of copper used, kg
Conventional car	23
Hybrid electric vehicles (HEV)	40
Plug-in hybrid electric vehicles (PHEV)	60
Battery electric vehicles (BEV)	83
Hybrid electric bus (Ebus HEV)	89
Battery-powered electric bus (Ebus BEV)	224-369 (depending on the size of battery)
* electric vehicle charger	0.7-8 (depending on kW)

Source: International Copper Association

The construction sector will continue to be a major driver of demand for copper. Especially, with the introduction of smart city infrastructure and buildings. The information technology systems within these building and infrastructure as well as the need to be energy efficient will continue to drive up demand for copper. Additionally, the increased prevalence of high copper intensity heating pumps and electrical heating systems is expected to boost copper demand.

In China, downstream demand is comprised of power (46 percent), household appliances (14.6 percent), transportation (11 percent), building and construction (9.4 percent), electronics (7.5 percent), and others (11.3 percent). The BGRIMM LiLan Consulting Ltd. expects semis production to grow by 4-5 percent year-on-year in 2021 in China (BGRIMM LiLan Consulting Ltd, 2020). In addition to starting from a low base in 2020 due to the COVID-19 pandemic, there are a couple of factors which are expected to contribute to this growth. First, strong investment in infrastructure-related projects, such as ultra-high voltage lines, large digital centers, new energy vehicles charging facilities, and wind power generation, will extend into 2021. Second, a positive growth in auto, aircon, and other general consumer goods production has been observed in 2021 due to recovery in Chinese demand. Third, stimulus policies, such as credit easing and lower borrowing costs in the real economy, will encourage manufacturers to restock.

3.1.2. Supply

In 2020, China alone accounted for nearly half of the global copper semis production capacity with a 46 percent share. North and South America combined had the second largest copper semi production capacity of 13 percent.

Table 3. 2020 Global copper fabrication capacity by region, thousand tons

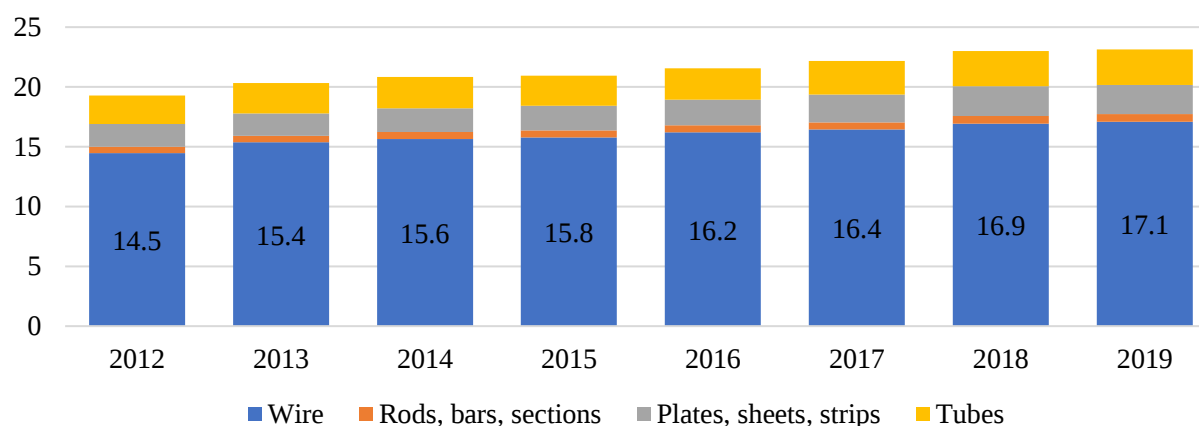
	Foil	Casting / ingot	Powder	Plates, sheets, strips	Rods, bars, sections	Tubes	Alloy wire	Wire rod	Not classified	Total
Existing Plants	1282.9	1246.1	64.2	6542.5	5080.7	5874.0	991.0	35,994.5	290.0	57,367.3
China	641.4	-	-	2651.8	1015.7	2828.4	356.4	19042.8	-	26,818.0
EU 27, UK, Norway, Switzerland	10.0	459.5	6.0	999.0	1800.9	694.1	225.9	2835.7		7011.1
Northeast Asia ex-China	414.6	174.0	11.5	978.7	654.8	490.5	186.0	2980.0	96.0	6004.1

North America	41.0	247.7	-	695.3	616.4	888.9	68.0	2771.8	18.0	5347.1
South East Asia, India, Oceania	135.6	171.6	20.6	372.3	420.8	589.8	74.3	3206.7	72.2	4817.1
Middle East and North Africa	2.5	81.7	-	87.0	224.0	142.9	6.9	2456.8	-	3071.1
South and Central Americas	35.8	38.5	-	506.5	217.7	227.0	64.8	1409.2	-	2418.7
Rest of Europe + Central Asia	2.0	39.7	26.1	202.0	54.0	87.4	5.4	1115.0		1531.6
Southern and Central Africa	-	23.4	-	49.9	76.4	25.0	3.3	176.5	-	348.5
Project Pipeline										
2021-2022	147.0			693.0	410.0	100.0	50.0	1497.0		2897.0
2023 and on				50.0				1400.0		1450.0
Total Capacity	1429.9	1246.1	64.2	7285.5	5490.7	5974.0	1041.0	38,891.5	290.0	61,714.3

Source: ICSG Directory of Copper and Alloy Fabricators 2020

In terms of type of copper product, wire rods make up around two-thirds of total global capacity. Due to the high conductivity nature of copper, copper wires are widely used around the world in various sectors and fields. As seen in the figure below, total global semi-finished copper product reached 23 Mt, an increase of only 0.6 percent year-on-year. The deceleration in growth lowered the global production CAGR from 3.0 percent to 2.6 percent.

Figure 6. Global semi-finished copper production by product, Mt



Source: International Wrought Copper Council

On the other hand, total global copper and alloy production reached 29.9 Mt, an increase of 0.2 percent year-on-year and a CAGR of 2.6 percent. Interestingly, production of copper wire is significantly more than that of alloy wire.

3.2. International case studies

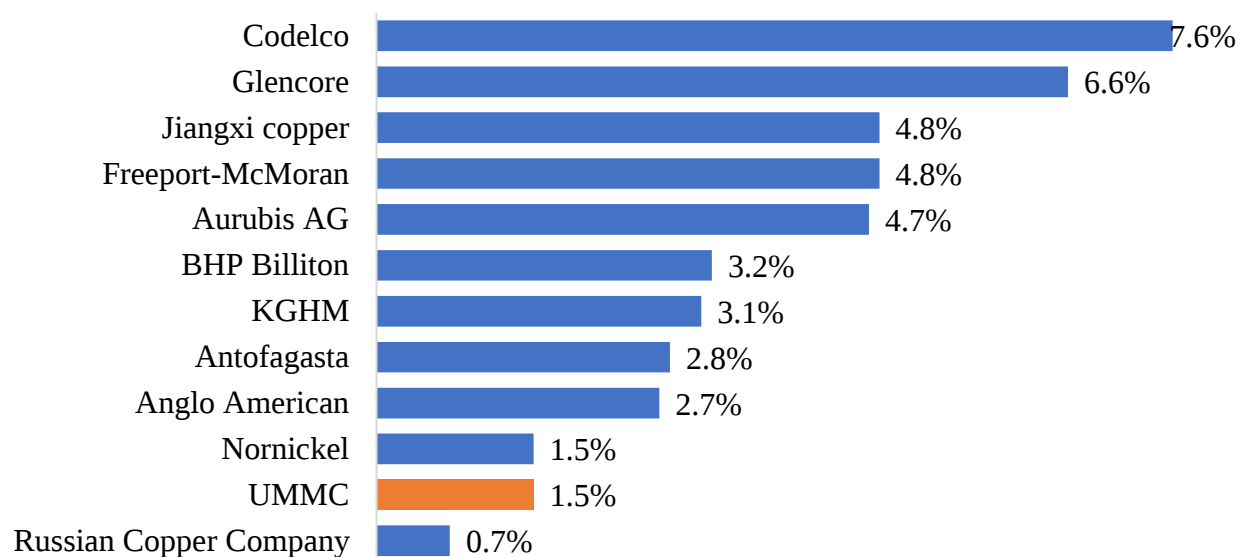
As mentioned above, copper smelting is one of the most widely known forms of copper processing. Refined copper typically refers to cathode copper while semi-finished copper refers to copper products such as wires, rods, tube, and more. The 2014 “Data Collection Survey on Copper Industry Sector in Mongolia” conducted by JICA extensively covers the process of copper

smelting. Therefore, in this study, the research team will aim to focus on the process after smelting, copper fabrication. However, several copper smelters produce both cathode copper and semi-finished copper products, such as the two international case studies below.

3.2.1. Russian SUMZ plant

Russia has been smelting copper for over 200 years and is one of the traditional producers of copper. Ural Mining and Metallurgical Company (UMMC) is one of Russia's top producers of major commodities such as copper, zinc, coal, gold, and silver. UMMC is the holding company of over 40 companies across Russia, accounting for 40 percent of Russian copper production, 25 percent of the precious metals market, and more than 50 percent of the European market for copper powder. On a global scale, UMMC accounts for 1.5 percent of the global share of refined copper and employs over 80,000 people.

Figure 7. UMMC share in world copper



Source: UMMC

Within UMMC, Ural Copper Plant OJSC or SUMZ (Среднеуральский медный завод or СУМЗ in Russian) is the largest copper smelter. The smelter plant was commissioned in 1940 and transitioned from a relatively small factory to a large chemical and metallurgical plant between the period from 1960s to 1980s. Until the 1950s, the plant used mostly US-made equipment comprised of General Motors engines. From early 1980s, SUMZ began reconstruction of the copper smelting furnace – the Vanukov furnace (Chen, et al., 2016). The first furnace was installed in 1994 with a total annual capacity of 100,000 tons and the second furnace was installed and commissioned in 2009.

Figure 8. SUMZ plant (Middle Ural Copper Plant OJSC is located in Sverdlovskaya obl., Russian Federation



Source: UMMC

SUMZ's annual capacity is around 150,000 tons of blister copper and employs around 3.5 thousand persons. The plant mainly produces blister copper and several byproducts, such as:

- Blister copper (produced in various sizes as per client requests)
- Copper wires 8mm in diameter, made by using Contirod technology, marked as MOO1, supplied in 3-5 tons.
 - From this, copper wires for cabling can also be produced on Niehoff's MSM-85 lines. The wire can be produced in both soft and hard forms with diameters of 1.15-4.5mm in 2-2.5 tons bundles.
- Cathode copper, in sheets, 99.95% copper content, supplied in bundles of 1.5-ton weight, certified by LRQA company in accordance with ISO9001:2008, branded at LME as UMMC and UMMCII, conforms with European standard of chemical safety REACH.
- Gold content in blister copper
- Gold refined
- Sulphuric acid

Table 4. SUMZ key financial indicators, 2013-2018

		2013	2014	2015	2016	2017	2018
Exchange rate	RUB/USD	31	38	61	66	68	62
Financials							
Total sales	mln USD	390.0	331.6	293.4	283.7	334.6	658.4
	bln RUB	12.1	12.6	17.9	18.7	22.8	40.8
Total operating profit	mln USD	29.5	29.5	69.9	69.5	44.4	44.7
	bln RUB	0.9	1.1	4.3	4.6	3.0	2.8

CAPEX	mln USD	42.8	25.3	13.8	13.2	14.7	11.5
	bln RUB	1.3	0.9	0.8	0.9	1.0	0.7
Product output							
Blister copper 95%	ton	141,435	135,938	139,510	140,393	117,557	90,031
Wire and cathode copper	ton		6,994	6,338	7,793	20,670	60,976
Gold in blister	kg		3,083	2,882	2,496	2,254	1,758
Refined gold	kg		1,726	2,441	1,989	1,946	1,942
Sulfuric acid	ton	816,487	845,407	853,324	829,531	795,183	786,513
Xanthic acid	ton	7,223	7,214	-	-	-	-
Revenue mln USD							
Blister copper 95%			139.5	122.7	114.2	92.0	78.4
Wire and cathode copper			44.9	35.9	37.9	111.5	414.8
Gold in blister			21.4	18.9	17.4	13.7	12.7
Refined gold			71.7	89.0	80.6	67.8	81.5
Sulfuric acid			14.0	10.5	15.0	20.0	33.6
Other			40.7	16.7	18.6	29.6	46.1
Operational costs							
Copper in copper concentrate	tons	13,942	12,197	13,882	12,157	13,216	14,112
Operational cost	mln USD		303.3	217.0	581.0	763.9	618.5
Number of personnel	persons	3362	3357	3195	3157	3151	3056
Taxes and social contribution	mln USD	28.4	23.5	15.4	14.9	16.0	16.6
	bln RUB	0.9	0.9	0.9	1.0	1.1	1.0

Source: *bf.arsagera.ru*, researchers' calculations

SUMZ's composition of product output has gradually shifted to also include production of copper wire on top of blister copper. From 2014 to 2017, the output of copper wire increased from around 6 thousand tons to 20 thousand tons. Revenue from copper wire also increased from USD 44.9 million to USD 111.5 million during the same period. From 2017, revenue from sale of copper wire exceeded revenue from other products.

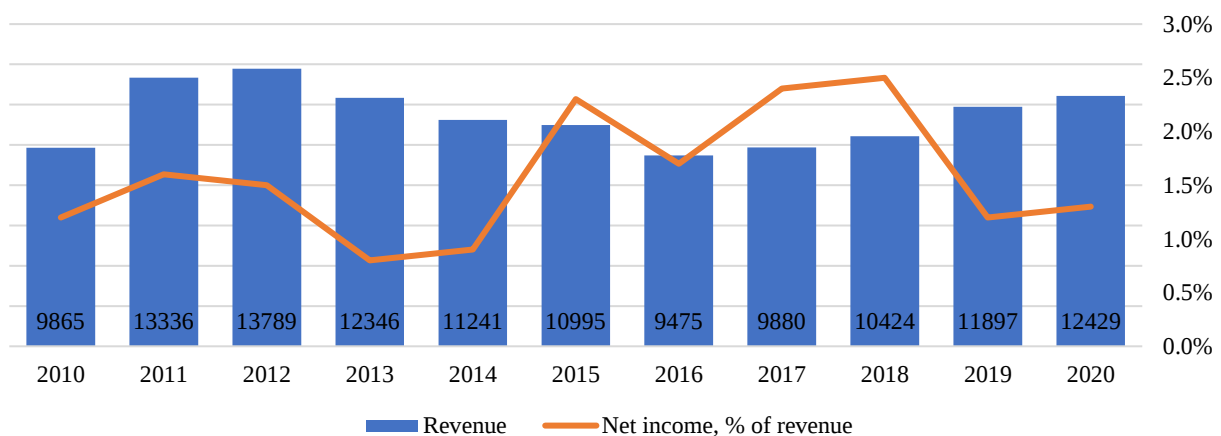
For instance, in 2017, of the USD 334 million in sales, USD 111.5 million was copper wire, USD 92 million blister copper, USD 13.6 million gold in blister, and USD 67.8 million refined gold. During the period 2014-2017, the average sale price of blister copper fell from USD 1026.32 per ton to USD 782 per ton while copper wire prices remained relatively stable – from USD 6424 per ton in 2014 to USD 5392 per ton in 2017. Despite the decline in average price of blister copper, SUMZ was able to maintain its total sales around USD 330 million by adjusting its product composition and increasing production of copper wires.

Prices of output products and raw materials are vital to the profitability of the plant. Therefore, product mixture contributes to the diversification of the plant and can assist in lowering the risks associated with dependence on one market. Additionally, strong demand from the export market help make the plant profitable, especially during periods when the domestic currency is in depreciation.

3.2.2. Aurubis

Aurubis AG was founded in 1866 and is headquartered in Hamburg, Germany. The company engages in the production of primary copper and precious metals, the recycling of secondary raw materials and the processing of copper into final products. Its product portfolio comprises of rod, specialty wire, such as cast rod, directly cast, oxygen-free copper rod and a variety of drawn products; shapes; industrial rolled products; architectural solutions for surfaces and facades; bars and profiles for the electro-technical industry; cathodes; precious metals, such as gold and silver, which are extracted from copper concentrates and secondary raw materials; sulfuric acid, iron silicate, selenium and recycled copper, precious metal and other non-ferrous metal products. The company also operates copper slitting service centers.

Figure 9. Aurubis AG revenue, million EUR, and net income as a percentage of revenue



Source: Company annual reports

The company has three main pillars of its growth. These are

- The processing of raw materials from the mining industry,
- The processing of recycling materials from preprocessors,
- The electronics industry, and product business.

Although Aurubis is the largest copper producer in Europe, their profit margins are low, around 1-2.5 percent of its revenue. Based on review of several copper fabricators, the profit margins tend to be very low for the industry. The company is able to maintain relatively stable financial indicators due to its vertical integration and market diversification. Additionally, the company has been the leader in transitioning the copper fabricating industry into utilizing copper scraps to lower their carbon footprint.

While Aurubis produces downstream copper products, one thing to keep in mind when comparing it with other copper fabricating plants is that the company is a multinational company with several affiliates and branches across the globe.

3.3. Mongolia copper downstream market

While Mongolia is very rich in copper concentrate, Erdmin LLC and Achit Ikht LLC are the only refined copper producers in Mongolia. These two plants are paving the way for Mongolia to develop the copper downstream industry.

- **Achit Ikht** was established in 2010 and produces copper cathode utilizing SX-EW technology and exports all of its production to China. The company began producing copper cathode in 2014 and has an annual capacity of 10,000 tons. Achit Ikht signed a long-term cooperation agreement with Erdenet Mining Corporation to build a copper cathode plant that would utilize EMC's low grade waste dump ore.
- **Erdmin** produces copper cathode and copper end products such as electrical copper wires and power extensions. Erdmin supplies these products to the domestic market. Erdmin began producing electric copper wires in 2005 and sells its products through its company stores in Ulaanbaatar and Erdenet. The company produces 2500 tons of copper products per year. The company produces 8 mm diameter copper wires without electrical insulation, which can then be further narrowed to produce copper wires with diameters of 1.04-8 mm. Erdmin manufactures more than 40 types of hard and soft electric wires, which are fully compliant with Mongolian MNS 60227 standards. Erdmin began producing copper wire extensions in 2012 (Montsame, 2017).

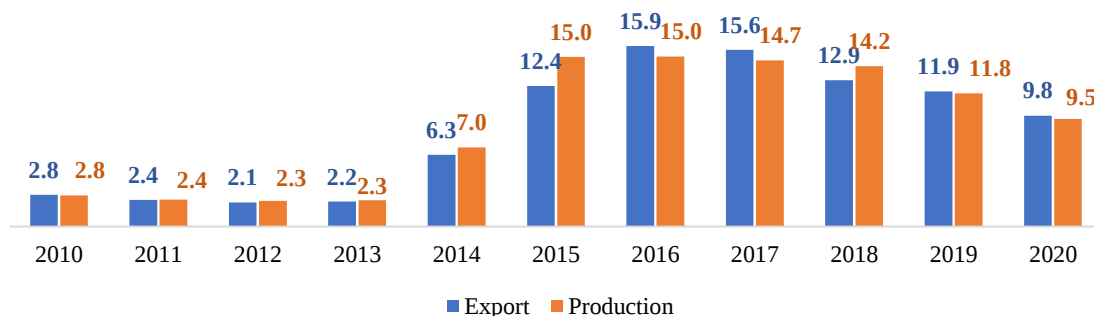
3.3.1. Domestic production and export

Production: During the last decade, total production of Mongolia's refined copper grew significantly. In 2014, Achit Ikht's production capacity was 3-4 times that of Erdmin. Due to the commission of Achit Ikht, refined copper output increased from 2.3 thousand tons in 2013 to 7 thousand tons in 2014. Since then, production has increased further to reach 15 thousand tons in 2015. However, since 2017, production levels have gradually declined.

In 2020, the two companies produced 9.5 thousand tons of cathode copper, a 19.4 percent decrease year-on-year. The drop in production was due to the decrease in the copper grade of the Erdenet's deposit dump from which it produces refined copper. Additionally, Achit Ikht has been unable to sell its products for some time as they have not renewed its license, opting to store its products outside the factory (ERI, 2021).

As for end-products, since 2013, Erdmin has been producing about 150 tons of copper wires annually (JICA, 2014).

Figure 10. Production and Export of Mongolia's refined copper, thousand tons



Source: Customs Office

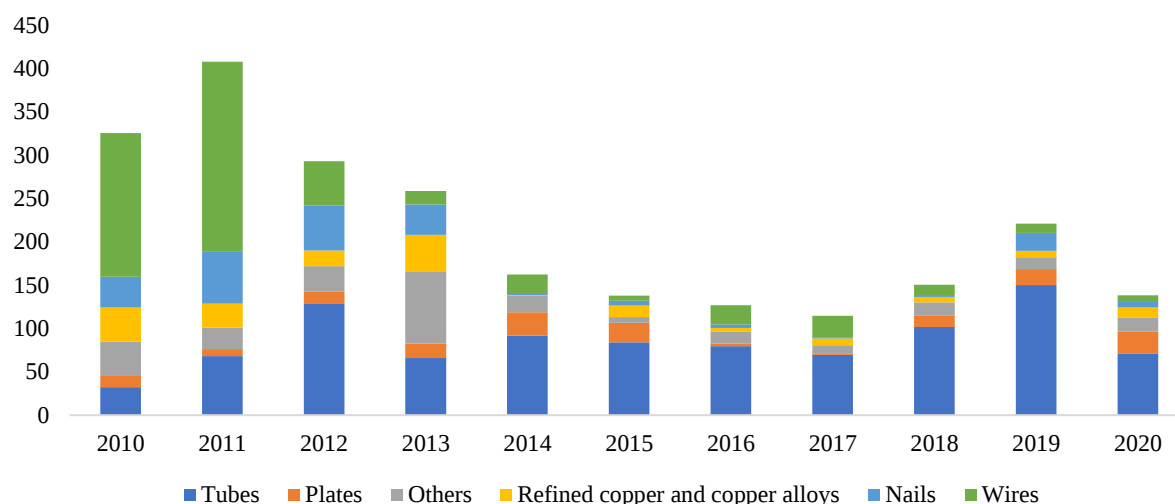
Export: According to the Customs Office, Mongolia's export of refined copper increased 3.5-fold from 2010 to 2020. Most refined copper exports constituted of copper cathode and alloys. As a result of Achit Ikht's emergence in the market in 2014, the industry output increased from 2.2 thousand tons in 2013 to 6.3 thousand tons in 2014. In 2015 and 2016, 12.4 thousand tons and 15.9 thousand tons of refined copper were produced, respectively. However, since 2017, export of refined copper has declined. This decrease was attributed to a contraction in production. In 2020, the refined copper exports dropped significantly to 9.8 thousand tons, declining 17.8 percent. Refined copper exports were normal in the first half of 2020 but declined significantly in the second half of the year compared to the previous year due to the lockdown measures related COVID-19 (ERI, 2021).

Excluding refined copper and alloys, Mongolia's copper end-products export consists of copper wires, copper tubes, copper, copper rods, copper nails and others. However, these products are not exported every year and are usually in small volumes. Erdmin exported small volumes of copper tube (HS code 7411), copper tube armature (HS code 7412) in 2015 and 2016 (ERI, 2017). Moreover, according to the Customs Office, Mongolia exported kitchen utensils between 2010 and 2012, some copper nails in 2017, and copper wires in 2017 and 2020. It was noted that Mongolia exported 154 tons of copper wires in 2020, which is a relatively large amount.

3.3.2. Copper product import

According to the Customs Office statistics, Mongolian import of copper end-products such as copper tubes, plates, nails, and wires was 325 tons in 2010 and 138 tons in 2020, declining by 57.5 percent. In the early 2010s, most of the refined copper import was copper wires. However, copper wire imports have fallen sharply since 2012. This is due to the fact that Erdmin produces and sells 150 tons of various electrical wires per year. In recent years, copper tubes imports have dominated. These products are mainly used in the construction sector.

Figure 11. Import of refined copper by products 2010-2020, tons



Source: Customs Office

3.3.3. Copper product consumption

Mongolian copper product consumption can be estimated by using export, import, and domestic production data. Based on our researchers' calculations, Mongolia's annual copper product consumption was on average 305 tons between 2010 and 2019. In 2011 and 2013, consumption was about 400 tons due to increased economic growth and business activities. Although copper product consumption increased significantly to 371 tons in 2019, it fell sharply to 133 tons in 2020. This decline was due to the export of 154 tons of copper wire in 2020.

Table 5. Mongolia's copper products export, import production and consumption (except for refined copper and copper alloys), tons

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Export	6	0	0	0	0	43	53	1	0	0	154
Import	257	381	269	239	162	138	127	115	150	221	137
Production¹				150	150	150	150	150	150	150	150
Consumption²	252	381	269	389	312	245	224	264	300	371	133

Source: Customs Office of Mongolia, JICA "Data Collection Survey on Copper Industry Sector in Mongolia" and research team calculation

During interviews with industry experts, information was obtained on the amount of copper products used in the construction industry. According to the construction sector expert, approximately 0.72 kg of copper products are used to for one square meter of an apartment. Based

¹ It is assumed that the production volume has not changed since 2013 and the production capacity has not been expanded.

² Apparent usage = Production + Imports - Exports + Beginning stocks - Ending stocks

Unfortunately, Mongolian companies do not publish stock data and the research team calculated apparent refined copper usage using available production, import and export data.

on the National Statistics Office data on the number of apartments commissioned and the data provided by the experts, the approximate amount of copper used per year can be calculated. It is estimated that a total of 750 tons of copper products was used in 2019. The copper products were used in power supply, lighting, and radio signaling. The amount of copper used in the construction of new buildings each year is significantly greater than that of statistics provided by the Customs Office. This may be due to the fact that some of the types of wires and cables listed by the Customs Office are categorized differently. For instance, the product category HS code 8500, which includes electrical machinery, equipment, and their parts, which may contain various types of cables and electrical wires such as copper.

As mentioned above, these copper products are mainly used in the construction sector. In other words, the consumption of copper products correlates with the construction sector performance. Construction output grew on average 30 percent per year between 2010 and 2019, with growth accelerating in early 2010s. However, in 2020, the construction sector's production declined due to the pandemic.

Production in the construction sector is expected to increase in the future. Within the framework of the national program of "150 thousand apartments" being planned to be implemented by the Government of Mongolia, construction sector production will likely increase. The program is expected to be completed by 2023. The Government Action Plan for 2020-2024 includes also redevelopment of the ger districts and inclusion of first-time homebuyers in subsidized mortgage loans with 4-6 percent interest. In addition to the above-mentioned programs, housing for 60 thousand households will be provided under the "Rental Apartments" program under Vision 2050. The infrastructure of these programs is also being addressed comprehensively. As a result, Mongolia's consumption of copper products will inevitably increase. So far, domestic output of copper products continues to exceed the relatively low domestic consumption.

3.4. Mongolia case study: Achit Ikh Copper AIC

In 2010, Achit Ikht LLC signed an agreement with EMC for raw material supply. After this, construction of the hydrometallurgical plant began. Once the feasibility study was conducted by the Beijing Institute of Mining and Metallurgy, construction commenced. The copper cathode plant was commissioned on 10 October 2014 as Mongolia's first modern hydrometallurgical plant with an annual capacity of 10 thousand tons per year. Full utilization rate was achieved in 2017 as the company was able to utilize the "Leaching-Solvent Extraction-Electrowinning" (L-SX-EW) equipment to process residual copper from waste ore.

The company is owned 34 percent by EMC and 66 percent by Achit Ikht, an offshore company. As highlighted in the previous sections, Achit Ikht is the leading producer of refined copper in Mongolia. The plant was financed by a USD 24.4 million loan from Noble Resource International, a Singapore based company and bank loan from Golomt Bank. The loan from Noble Resource International, which was secured in 2013, was fully repaid ahead of schedule in 2018.

Due to the significant impact of the plant on the surrounding environment, the company also established social responsibility programs in Orkhon province, where the plant is located. For 2021, the company set a 10-point program in collaboration with the local government consisting of environmental protection, education, youth development, employment support, local business

development support, creation of a park, creation of a chemical lab at a local school. From 2014 to 2019, the company has paid a total of MNT 153.287 billion in taxes; of which, MNT 137 billion in national taxes and MNT 15 billion in local taxes.

The company received the production license UN-000001 in June 2017 after amendments to the Mineral's Law on 10 November 2016 from the National Development Agency. The firm also received, according to the Law on Investment of Mongolia, a taxation stability agreement certificate from the NDA based on Decree 16/08 of the Investment Council and Decree A-96 of the Chairman of the NDA on 3 August 2017. The company obtained the "Cathode copper factory project Taxation Stabilization Agreement for 6 years" after operating for 3 years and paying MNT 68 billion in total taxes to the national budget. The taxation stabilization certificate is applicable to corporate income tax, value-added tax, customs tariffs, and royalty taxes for 5-24 depending on the initial investment amount.

Additionally, the company became a member of the London Metals Exchange in February 2019. The membership adds credibility to the company's production of 10 thousand tons of LME Grade A copper cathode of 99.9935%. In addition to the hydrometallurgical plant, the company has also the necessary infrastructures, which consists of: 6 km 35 KW electricity line with two power sub-stations, 1200 m³ tank for acid storage, 200 meters of railway, 2.4 km of road, and a heating power station.

The Achit Ikht case is an ideal example of starting a downstream project in Mongolia. First, prior to constructing the plant, the company was able to sign an agreement with EMC for raw material supply. Second, the company was financed using private investment. Third, the company was able to become a member of the LME. Finally, a taxation stability agreement was obtained from the Government of Mongolia. The hydrometallurgical plant is a good example of how a downstream project may be started and operated.

3.5. Infrastructure development

Mongolian exports are limited by its transportation and border capacity. According to the World Economic Forum, in terms of infrastructure competitiveness, Mongolia ranked 103rd out of 140 countries in 2019. Additionally, according to the logistic performance index by the World Bank, Mongolia ranked 129th out of 169 countries due to inefficient clearance process by border control agencies, lower quality of trade and transport related infrastructure, incompetent logistics services such as transport operators and customs brokers, and inability to track and trace consignment.

For instance, coal mining companies at Tavan Tolgoi, the largest coal deposit in the country, have to transport their product by trucks to the border port. However, there tends to be traffic congestion due to slow border control and inspection processes on both sides of the border – Mongolia and China. Despite the measures taken to make border crossings more efficient, the difficulties related to loading and unloading supplies, queuing and transportation are still a major challenge (ERI, 2018).

In addition to transporting cargo through the border, Chinese and Mongolian drivers must also be checked and go through the immigration process. This creates an extra hindrance in the clearance process, especially, during the COVID-19 pandemic. Although the government planned to build a railway from the Tavan Tolgoi mine to Gashuunsukhait border port in 2011, the completion of the

project was delayed due to political and financial issues. Finally, in 2019, the construction work of the planned railway resumed as the issues were resolved and is expected to be completed in 2022.

As of May 2021, around 92 percent of the 220km Tavan Tolgoi-Gashuunsukhait railway was completed and the 416 km Tavan Tolgoi-Zuunbayan railway was completed. The new railway routes are expected to increase the competitiveness of Mongolian export commodities by decreasing transport costs and increasing the access to border transportations for various mine deposits and processing plants.

Another railway which is currently being discussed is Khangai. The Khangai railway could bypass the bottlenecks at the Zamiin Uud and allow for the export of iron ore to Baotou Steel Plant in China from Mongolia. Currently, the Ulaanbaatar Railway is the only operating carrier and their freight tariffs tend to be very high. Therefore, the construction of a 281 km railway from Zuunbayan to Khangai could resolve these issues and further increase the competitiveness of Mongolian mineral exports.

In 2020 the newly elected government announced to establish a national transportation and logistics network based on the smart transportation system in its action plan for 2020-2024. It includes construction of railways, highways, and paved roads.

For railway, the priority is

- to complete the construction of Tavan Tolgoi-Gashuunsukhait and Tavan Tolgoi-Zuunbayan bound railroad in 2022. The new railways will not belong to the existing Mongolia-Russia UB railway company and will mostly operate as part of a domestic national railway company.
- Further, Khuut-Bichigt, Khuut-Choibalsan in Mongolia's Far East (Dornod) and Zuunbayan-Khangai (mainly for iron ore export) in Dornogobi railroad construction projects are also considered.
- GOM also plans to commence the technical and park renovations of Ulaanbaatar Railway and carry out overhauling of 200 km railroad, and to prepare the feasibility study of Bogd Khan railway (which is planned to circle Ulaanbaatar and provide faster direct shipment routes). While it is not directly related with downstream industries, the new logistics will provide a better infrastructure support for northern deposits of iron ore, reducing their transportation costs and time.
- Current plan is to create a free economic zone, centering in New Ulaanbaatar international airport (NUBIA), with a plan to connect it to the new Bogd Khan railway line around Ulaanbaatar to create a logistical center.

For road projects, the priority is

- to complete the construction of making AN3 of the Asian Highway Network (Altanbulag-Darkhan-Ulaanbaatar-Bayan) roads with 4 lanes and AN4 (Tsagaannuur-Ulaanbaishint), to continue the construction of vertical and horizontal axis auto roads of Millennium road network and to implement paved road projects to link major urban

settlements to border checkpoints. The ADB and EBRD financed road projects related to AN3 are currently under construction, slated for 2022-2023 completion.

- Secondly, the government is planning to develop environmentally friendly, accessible, sustainable and safe transportation services that meet the demand.
- Third, the government also aims to establish a dry port that meets the international standards and based on the railway network, and to commence the project to develop airports in Khovd, Dornod and Khuvsgul provinces of 4C category.

For **power solution**, the Tavantolgoi Power Plant project is being now reopened for tenders as a joint venture, mostly owned³ and financed by the Government of Mongolia. It is planned to have 450-megawatt (MW) coal-fired power capacity to provide power for the Oyu Tolgoi copper mine, and on 28 June 2020, the Government of Mongolia and Oyu Tolgoi LLC signed an Memorandum of Agreement for the plant, which included signing a Power Purchase Agreement in 2021 and the opening of the power plant in 2025. In April 2021, the Energy Regulatory Commission posted a notice that the project would be implemented over a period of 42 months and would require a total investment of US\$808.2 million.

³ 50 percent of the state-owned shares of Tavantolgoi Tsakhilgaan Stants (Tavantolgoi Thermal Power Plant) LLC will be held by the Ministry of Energy, 30 percent by Erdenes Tavantolgoi JSC, and 20 percent by the Government Agency for Policy Coordination on State Property.

3.6. Financial possibilities

For the development of the downstream industry, a number of critical conditions have to be met. These basic conditions include market demand for product, availability of necessary infrastructure and logistics, skilled human resources, abundance of raw materials, financing, and supportive policies. With the accelerated development of Mongolia's financial system over the past decade, the only source of financing is no longer foreign direct investment. Some of the possible domestic financing for downstream projects are⁴:

- Commercial banks (investments in copper smelter in Erdenet, Achit-Ikh LLC, and railways have already been made)
- Private domestic investment⁵ (Gobi coal handling facilities, copper smelting, iron bar production)
- Development bank (various mining and industrial projects)
- Foreign direct investment and foreign borrowing (copper, coal, oil)
- Concessions and other forms of public-private partnerships⁶ (southern Gobi highway)
- State budget investment and sovereign wealth funds (mainly used to support the Development Bank of Mongolia through guarantees and finance social infrastructure projects)
- Foreign development loans (used for the Dornogobi oil refinery project)
- Foreign direct loans/bond issue and initial public offerings (Erdenes Tavan Tolgoi bond issuance in 2021 used to finance various infrastructure and downstream projects)
- Investment or ownership by state-owned enterprises (Erdenes Mongol LLC and Erdenes Tavan Tolgoi JSC)

In the following section, the various financial resources available for downstream industry funding are considered:

- Commercial banks
- Development bank
- Initial public offerings or public corporate bonds
- External assistance and foreign borrowing/investment
- State-owned enterprises as direct investors

⁴ When the Oyu Tolgoi investment agreement was signed in 2009, the only financial resource available was foreign direct investment as Mongolia did not have a system of development banking, concessions, foreign direct loans, and initial public offerings.

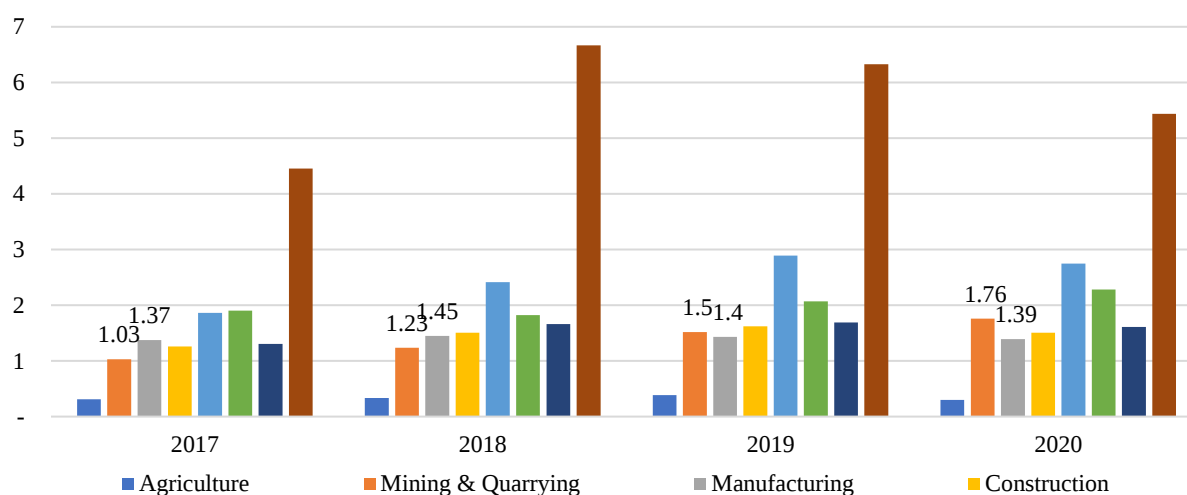
⁵ More than USD 3 billion in private financing have been raised by Mongolian companies, such as Energy Resource, Trade and Development Bank, Mongolian Mortgage Corporation, and more. These financings are being used to support various economic projects; the largest one being the CHP plant in Ukhua Khudag by Energy Resource with a capacity of 15 Mt of washed coal.

⁶ The largest completed projects under the new concession framework are the heavy-duty highway for mining trucks through southern Gobi (2011), a power plant, and several smaller projects. However, concessions are not widely used for downstream projects and are instead used for large infrastructure projects in Mongolia.

3.6.1. Banking system

As of the end of 2020, there are 13 commercial banks operating in Mongolia. Of which, one is state-owned. Total loans outstanding of the banking sector was MNT 17 trillion in 2020, a decrease of 5 percent from the previous year. Of the MNT 17 trillion loans outstanding, 60 percent is normal, 21 percent have been affected by COVID-19, 12 percent are non-performing and 7 percent are in arrears. Over a fifth of the loans issued for the agriculture, mining, and manufacturing sectors are non-performing.

Figure 12. Commercial bank loans outstanding by sector, trillion MNT



Source: Bank of Mongolia

To combat the adverse impacts of the pandemic on the economy, the Bank of Mongolia and Government of Mongolia has been implementing a number of programs to protect the public's health, support livelihoods, and revive the economy. The programs which have begun implementation are loans to support job, repo financed loans for SMEs, and loans to support agricultural sectors. These policies are being implemented through the commercial banking system, which implies that the government could provide developmental support for the mining sector and downstream processing through this new avenue. With the influx in loan issuances and rising non-performing loans, the likelihood of commercial banks issuing loans to downstream processing projects are likely difficult in the near term. Another obstacle in obtaining a loan from commercial banks for projects in the downstream industry is high interest rates, which corresponds to the riskiness of the project. However, there have been instances where commercial banks have assisted in the financing of various mining, manufacturing, and processing projects in Mongolia, such as the Sainshand Wind Park, Achit-Ikh, and more.

The average weighted interest rate of loans issued in May 2021 were 15.1 percent for private entities, 5.9 percent for state-owned enterprises, and 5.7 percent for other enterprises. Although the Bank of Mongolia has been implementing policies to lower interest rates, the interest rate of loans remains high. However, some bank loans for projects supported by international institutions have lower interest rates ranging from 3-8 percent.

3.6.2. Development Banking

The Development Bank of Mongolia was established on 25 March 2011 pursuant to Resolution No. 195 of the Government of Mongolia dated 20 July 2010 and commenced its operations in May 2011. The Bank is 100 percent wholly owned by the Government of Mongolia and is regulated under the Revised Law on Development Bank of Mongolia rather than the Central Bank Law and Bank of Mongolia regulations applicable to commercial banks. At least 60 percent of the projects financed by the Bank must promote export-driven programs that enhance Mongolia's ability to export value-added products, especially in non-mining sectors of the economy. In other words, the main purpose of the Bank is to provide concessional loans and financing to support the growth of sectors that are of significant importance to the sustainable development of Mongolia's economy.

Some of the projects which have been completed and were financed by the Bank were: capacity expansion of the Baganuur coal mining, capacity expansion of the combined heating and power plant No. 3, "Moncement" project, Khutul cement production plant, and Amgalan thermal power plant. All these projects were included within the government's medium-term target programs. The ongoing projects include providing soft loans to SMEs for factory capacity expansions, the affordable 1152 housing construction next to Yarmag Bridge, and the Tavantolgoi power plant.

The main requirements which must be met for projects and programs to receive financing from the Bank are:

- Requested amount for financing must be more than MNT 20 billion, or its equivalent in foreign currency
- At least 15 percent of the total cost of the project must be covered by the project implementer or other investors and financial institutions
- The project or program must be export-oriented, as in, the project produces or exports goods or services, provides direct support to exports, such as expanding export activities and mining infrastructure
- The feasibility study must be completed
- In the case of a program, a strategic environmental assessment or an environmental impact assessment must have been conducted and approved
- The projects and programs have to be implemented within Mongolia
- Loans to completed projects will not be refinanced

The interest rate of these concessional loans were around 12.44 percent for MNT in the first half of 2020. However, this interest rate is for projects with unclear funding. Therefore, depending on the borrower's risk level and other conditions, the interest rate might be lower.

3.6.3. Initial public offering or public corporate bond

The Mongolian Stock Exchange was established in 1991 to assist in the privatization of state-owned enterprises. Over the past three decades, the exchange has been developing rapidly, especially since 2018. In 2018, the exchange recorded 8 initial public offerings, a record-breaking amount. The wave of IPO was started by LendMN, a fintech company. In 2019, there were two IPOs, Invescore NBFi and Bodi Insurance. A large number of the IPOs have been financial

services. Based on the oversubscription of these IPOs, the public involvement and interest seems to be high.

Although IPO issuances seem to have halted in 2020 and the first half of 2021 due to COVID-19, there will be a couple of IPOs announced in 2022. On 28 January 2021, the Parliament of Mongolia enacted the Law on Amendments to the Banking Law of Mongolia, which went into effect from 25 February 2021. One of the notable amendments in the law is that systemically important banks must revise their corporate form to be an open joint-stock company while the remaining non-systemic banks are required to operate in the form of a closed joint-stock company. The change in corporate form will take effect from 30 June 2022, therefore, a number of large Mongolian banks will be announcing IPOs soon.

With the emergence of fintech companies and commercial banks on the exchange, the ability for a processing company to raise funds through an IPO is very low. One of the challenges faced by the stock exchange is the lack of institutional investors (ERI, 2019). The few institutional investors in Mongolia will likely be more interested in investing in commercial banks with their long track record and domination of the financial system in Mongolia than in a new, downstream processing company which may be high risk and is known to have low profit margins. Additionally, since 2019, Erdenes Mongol and Erdenes Tavan Tolgoi have been discussing the possibilities of raising funding for a number of industrial projects through domestic and foreign IPO; however, these plans were halted due to the 2020 parliamentary election and COVID-19 pandemic.

The MSE also facilitate issuance and trading of debt securities. Government bonds account for a majority of the total Mongolian bond market; however, under the International Monetary Fund's Extended Fund Facility program, government bond issuances were temporarily halted under the country's debt level and management improved. The MSE first started trading corporate bonds in 2001; however, due to the small-scale and underdevelopment of the market, there have only been a handful of public corporate bond issuances. Private placement corporate bonds are not regulated except in a broad scope by the Securities Market Law and Financial Regulatory Commission regulations regarding debt securities. However, according to a study conducted in 2019, the private placement market is relatively active due to the lack of regulations. One caveat of the market is that the total value of the market is estimated based on willingly publicized information and therefore, remain unregistered.

Erdenes Tavan Tolgoi (ETT), a Mongolian state-owned joint stock company, launched a three tranche ETT bond to raise MNT 2 trillion as a part of the Comprehensive MNT 10 Trillion Plan. The first tranche of the bond was successfully held in late March 2021 with an interest rate of 10 percent for MNT and 6.8 percent for USD. The bonds will be used to finance mega construction projects, such as the Tavan Tolgoi thermal power plant, coal concentrator, water supply, and railroad. Government bonds are considered reliable investment instruments and as the government is a majority shareholder in the company, the bond through association may be considered as a government security. However, the company explained that "the bond will have no guarantee from the government" and it "will not affect the government's debt ceiling."

Although the success of the ETT bond provides another source of funding for downstream projects, it should also be noted that the bond was issued under special circumstances. These include the

fact that the company is state-owned, the bond issuance was part of a government action plan, and the company is relatively large and well known.

3.6.4. External assistance and foreign borrowing

In the case the project or implementing company is state-owned, there is a possibility that the project may be financed from the budget. In other words, the government could provide financing by raising funds through government bond issuances or allocating funds for projects to be implemented under their action plans. However, this could potentially further burden the state budget. In 2020, the government borrowed a number of loans to finance the measures implemented to combat the pandemic and its effects. Additionally, several government bonds issued on international markets are maturing in the coming years. Therefore, the possibility of the government raising funds for projects through bond issuances or loans is minimal considering the high level of debt which exists currently.

However, a project may be eligible for one of the project loans offered by various international development and financial organizations. Some of the development partners, such as the World Bank, International Finance Corporation, European Bank for Reconstruction and Development, Asian Development Bank, USAID, International Monetary Fund, and the Japan International Cooperation Agency. These organizations all offer programs or assistance in capacity building for several sectors for the development of Mongolia. For instance, JICA offers 8 percent interest rate project loans through commercial banks under their Two-Step Loan Project for Small and Medium Scale Enterprises Development and Environmental Protection.

3.6.5. Foreign investment

Mongolia is relatively open to foreign investment and investors. With its strategic location with to access two large markets – China and Russia – and a wealth of high-quality natural resources, there is an extensive amount of opportunities for foreigners to establish partnerships in Mongolia. In addition, FDI has been the engine of Mongolian economic growth and is highly dependent on commodity prices.

FDI inflow to Mongolia peaked in 2011 at USD 5.7 billion due to the Oyu Tolgoi project's investment. However, it continued to decline until 2015, reaching a record low of USD 1.4 billion in 2015. In 2020, FDI inflows to Mongolia amounted to USD 2.6 billion, fall from USD 3.1 billion in 2019. This decrease can be attributed to the 29 percent year-on-year decrease in investment into the mining sector which constituted 65.6 percent of overall foreign direct investment.

Mining investments, the bulk of FDI in recent years, half of which has been in the Oyu Tolgoi project, have come to a halt. The Oyu Tolgoi copper and gold mine expansion project, which had already been delayed. In detail, Rio Tinto announced that due to changes in ground stability conditions, it was necessary to change the design of the underground mine and update the Feasibility Study. With the introduction of the revised Feasibility Study in late 2020, total funding for the underground mining project increased to USD 6.8 billion, and production was postponed to October 2022.

Figure 13. FDI inflow in Mongolia, by sectors, million USD

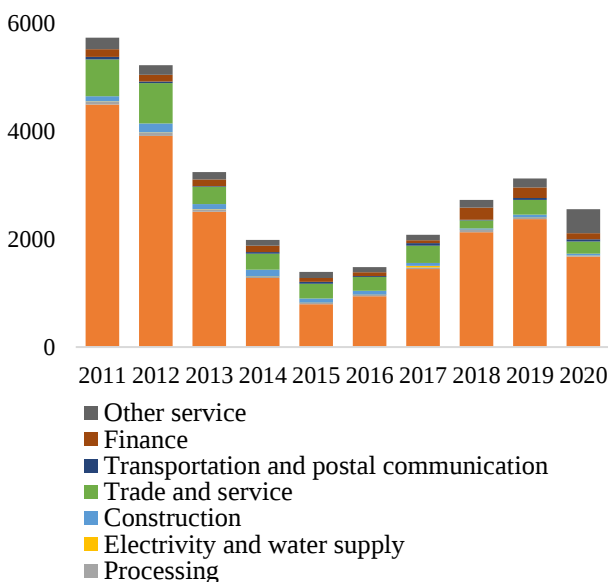
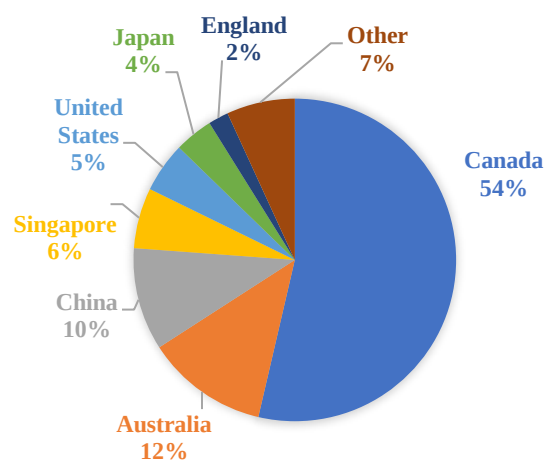


Figure 14. FDI inflow in Mongolia by country, 2020



Source: Bank of Mongolia

Mining and quarrying sector is the main sector for FDI and constitutes 70 percent of total FDI on average between 2010 and 2020. Another significant sector is the sales service sector, which accounts for 13 percent of total FDI on average between 2011 and 2020. Meanwhile, total investment to the processing sector attributed to average of 4 percent in the last decade. In terms of investor countries, the majority of foreign direct investment in Mongolia comes from Canada and followed by Australia and China. Almost all investment from Canada and Australia is in the mining sector.

As mentioned above inflow of foreign direct investment was largely determined by investment into the mining sector with investment into Oyu Tolgoi making up the majority. In detail, Rio Tinto announced that The Oyu Tolgoi mine expansion project had been delayed. It was necessary to change the underground mine design and update the Feasibility Study due to changes in ground stability conditions. With the introduction of the revised Feasibility Study in late 2020, total funding for the underground mining project increased to USD 6.8 billion, and production was postponed to October 2022. Construction of the underground mine is likely to be delayed to some extent due to the inability of foreign experts to visit Mongolia after the closure of the border to avoid the risk of COVID-19.

4. Pre-feasibility study of constructing a copper fabricating plant in Mongolia

The demand for semi-fabricated end use products has grown steadily over the last few years and its growth trajectory remains positive. The three areas of growth for copper are: renewable electricity generation, building construction sector, and electric vehicles. The surging renewable energy sector relies on the unique conductive properties of copper to improve efficiency. This preference is expected to continue with copper being used in battery energy storage, an area expected to grow by between 30-40 percent per annum (Metra Martech, 2021). The increased prevalence of copper in heating pumps and electrical heating systems will boost demand in the construction sector. The number of electric vehicles, which rely on copper in many of their functions, is expected to increase further due to technological advancements that increase vehicle performance and reduce battery costs.

Based on these future demands, the type of semi-fabricated products which is likely to be highest in demand is copper wire. Specifically, copper wires for electrical purposes. This preference is already apparent in the global production of semi-fabricated copper products. Copper wire rods account for two-thirds of total production capacity and within that, China is the main producer.

Although China dominates the market for copper production and demand, there are several reasons to construct a copper fabricating plant in Mongolia.

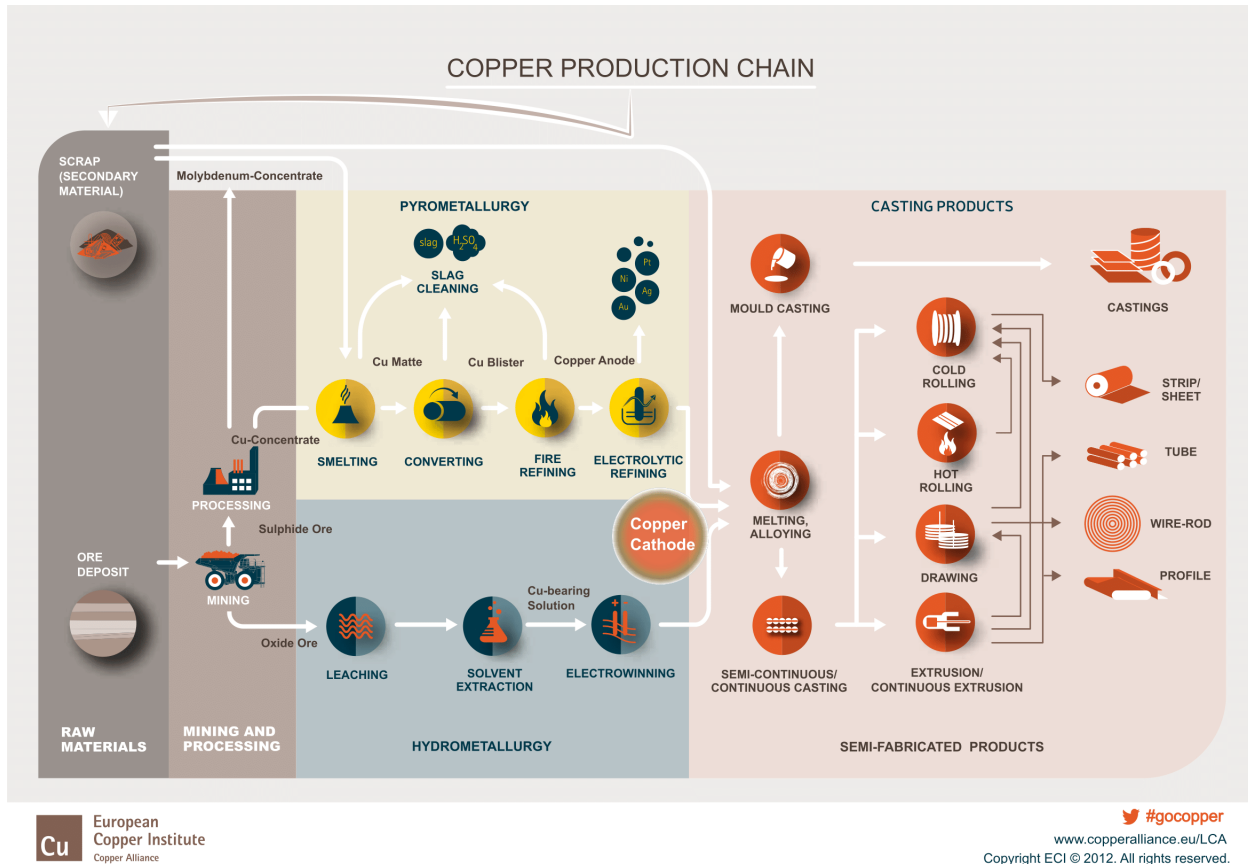
- Further develop Mongolia's downstream processing sector, which aligns with the Government Action Plan and other developmental policies
- Diversify the economy and shift reliance on raw mineral commodities to process goods and services
- Broaden export products to include value-added products (i.e., develop copper concentrate extracted from Mongolian mines into cathode copper and then copper wire for end-use)
- Create additional jobs for the economy
- Develop Mongolia's higher education and human resource capacity in engineering fields
- Create additional tax revenue for the Government of Mongolia in the form of corporate income tax, value-added tax, and royalty surtaxes
- Close proximity to a main export market (China) and established railway systems between the two countries

Therefore, one of the objectives of this study is to construct a pre-feasibility study of a copper wire manufacturing plant. Through this, the research team hopes to highlight some of the challenges faced by the industry as well as to provide some guidance on the policies that are needed to develop the industry. To clarify further, the plant which is being evaluated is not currently being discussed or planned. In other words, it is a hypothetical copper wire manufacturing plant that will be used to highlight some of the key operating costs and risks. An evaluation of a copper smelter is not being conducted as a number of studies have already done so, such as the 2014 "Data Collection Survey on Copper Industry in Mongolia" report conducted by JICA. Currently, there is only one copper fabricating plant in Mongolia, Erdmin LLC, which was reviewed in Section 4.1.

4.1. Technology

The main technology used to process cathode copper into copper wire after melting it in a furnace is semi-continuous or continuous casting. The difference between semi-continuous casting and continuous casting is its flexibility in terms of producing different products and the volume of output. Continuous casting is suitable for high volume, single product production whereas, semi-continuous may produce less but of various lengths and diameters.

Figure 15. Copper production chain



Source: International Copper Association

Another difference in technology in copper wire processing is whether the continuous casting is vertical or horizontal. In vertical continuous casting, the products are moved downwards from the casting machine. After reaching the maximum depth of the plant, the casting is stopped, and the strands are removed from the system. In horizontal continuous casting, the strands are pulled horizontally out from the casting system and coiled. The casting runs continuously until metal in the furnace runs out.

During the continuous casting process, cathode copper is first melted down in a cathode shaft furnace under strict process monitoring. The 1200 degrees Celsius molten copper is then transferred or poured into the casting machine. These copper bars are then entered into a rolling line, which is made of many roll stands. Diameters between 23.5 to 8 mm can be attained by

constantly reducing the cross section. The 400-500 degrees Celsius rod is then surface treated and cooled at a constant speed. the temperature is subsequently reduced to 40 degrees Celsius. After it is dried and treated with a protective wax coating, the rod is wound into coils with a weight of 3.5 to 10 tons. The continuous cast rod can then be further processed by drawing or rolling into individual wired, braids, cable, enameled wire, flat wire, and profiles.

The technologies which were chosen for the pre-feasibility model was horizontal continuously casting and drawing. A horizontal continuous casting process will first be used to create copper rods of 8 mm, which will then be feed into a copper drawing machine to create copper wires of 3 mm. Therefore, the hypothetical copper fabricating plant will consist of two types of machines, a horizontal continuous casting machine and a copper wire drawing machine.

4.2. Methodology

To evaluate the hypothetical copper fabricating plant, a financial analysis will be conducted. Financial and economic analyses serve two different purposes – financial analysis is used to calculate an expected return on investment to prospective investors while an economic analysis reflects the project's net benefit to the society as a whole.

A financial analysis will model revenues and operating expenditures to determine the expected annual cash flows. These projections are based on several assumptions and parameters, including but not limited to, price of cathode copper and copper wire, operating costs, annual production capacity, taxes, and financing options.

The projected annual cash flows, derived by subtracting operating expenditures from revenue, will be discounted using a modified discounted cash flow (DCF) to determine the project's value and returns. The net present value (NPV) and internal rate of return (IRR) will be determined using the free cash flow calculated via DCF.

4.3. Assumptions

The financial analysis is comprised of a number of assumptions and parameters. One of the largest assumptions being made for the financial analysis is that this plant will be built in the newly announced "Mining, Metallurgy, Chemical Industrial Complex" by Erdenet Mining Corporation (EMC). One of the planned projects for the industrial technological park is a copper smelting plant, which will serve as the main source of raw material for the copper fabricating plant. The cathode copper produced from the Erdenet copper smelter will be further processed by the plant to produce copper wires and rods, which will be exported. The location of the park is ideal as it is close to the copper mine and Mongolian railway.

Another large assumption is that the infrastructure required for the copper fabricating plant, such as power plant, water supply, and railway, are already established and therefore, the plant does not need to incur the costs associating with constructing and maintaining these infrastructures.

4.4. Revenue

To project the annual revenue for a copper fabricating plant, the most suitable method is the price-volume approach. In the price-volume approach, estimations of future prices and volumes per

product are used to forecast future revenue. The volume of product is based on the annual capacity of the plant. In order to test the various scenarios, the financial analysis includes three levels of annual capacity: 6,000 tons per year, 60,000 tons per year, and 120,000 tons per year. The capacity levels indicates how many tons of copper wire of 3 mm can be produced per annum.

As the continuous casting process cannot be stopped and restarted without incurring additional losses, the plant is assumed to be operational 24/7, 330 days. During the month when operations have been halted, maintenance of the machinery and equipment can be conducted.

As for the price of copper wires, it depends on quality, conductivity, and metal mixtures. For the purpose of simplicity, only one type of product will be produced – an oxygen-free, 99.9 percent copper wire of 3 mm. As the main export market for the product will be China, the set price for the product is derived from the Shanghai Metals Exchange Market (SHMET)⁷.

According to SHMET, as of 1 July 2021, the daily average spot price for an oxygen-free copper wire of 3 mm was RMB 69,530 per ton. This spot price includes China's value-added tax of 13 percent. Therefore, for the financial analysis, this spot price has been converted to USD using the exchange rate of the respective day (6.4635 RMB/USD) and VAT has been deducted. Excluding VAT, the price of copper wire is 9358.88 USD per ton. For the purpose of competing with copper wires manufactured in China, the selling price of the copper wires produced by the copper fabricating plant includes Mongolia's 10 percent VAT. The selling price of the domestically produced copper wire is then USD 10295 per ton.

Table 6. Revenue per annum, per capacity level with spot price of USD 10,295

	6,000 tons	60,000 tons	120,000 tons
Spot price of USD 10,295 per ton	USD 61.77 million	USD 617.69 million	USD 1.23 billion

Source: researchers' own calculations

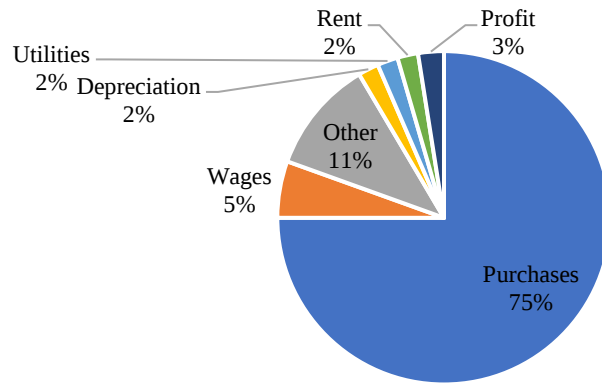
Based these estimates and calculations, for a plant with 6,000-ton capacity, the annual revenue will be USD 61.77 million, 60,000-ton capacity will generate USD 617.69 million, and a 120,000-ton capacity plant will generate USD 1.23 billion in revenue. A sensitivity analysis will be conducted in Section 5.8 with various prices to determine the impact on NPV and IRR.

4.5. Expenditure

The next portion of the financial analysis consists of determines operating costs. Operating costs are the expenses incurred during normal project operations, and may include expenses such as rent, equipment, inventory cost, marketing payroll, insurance, and others. Based on a 2013 IBISWorld industry report of copper tubes and wire manufacturing, a cost structure was determined. The research team utilized this cost structure as a guide to construct a relatively realistic financial analysis of costs and revenues of a copper fabricating plant.

⁷ SHMET is the most professional information provider for the metals industry in China. It is also one of the three most renowned institutions in the non-ferrous metals industry, along with London Metal Exchange and Shanghai Futures Exchange.

Figure 16. Cost structure of copper tube and wire manufacturing industry



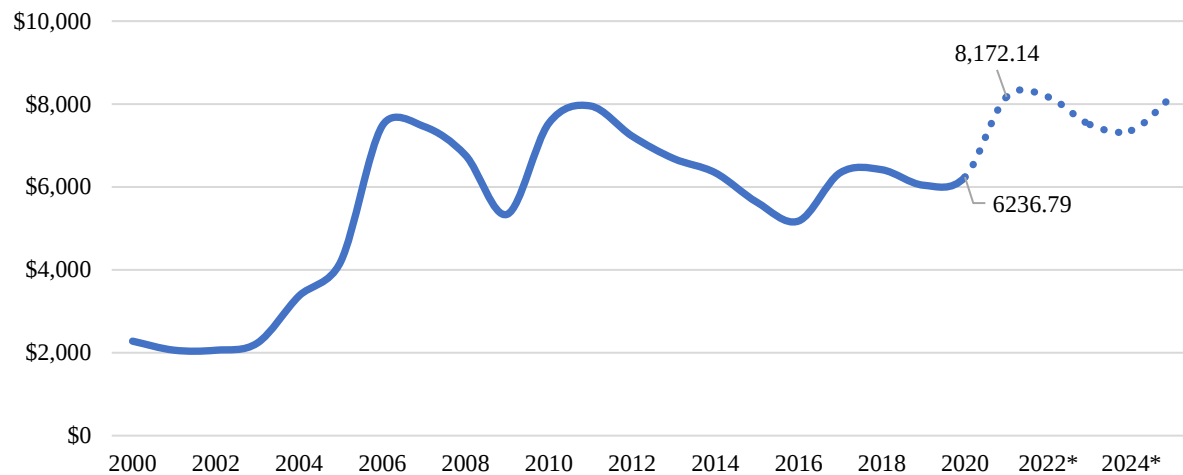
Source: IBISWorld

Material purchases make up three-quarters of annual revenue in the industry. The key inputs into production of copper wires and tubes are copper, energy, and oil. Other purchases include expenses related to packaging, logistics, and distribution. The other expenses include utilities, general administration expenses, logistics, and research and development costs. However, on average, only 2.5 percent of annual revenues end up as profit. This was reflected in the Aurubis case as well.

As cathode copper accounts for a large portion of operating expenses, the purchase price is crucial. Due to the inherent volatility of cathode copper prices, the ability to stabilize prices in the form of contracts would be ideal for the fabricating plant.

The spot price of cathode copper on SHMET as of 1 July 2021 was RMB 59,586.3 per ton, excluding VAT. This is approximately equal to USD 9218.89 per ton. The current spike in copper prices are due supply disruptions caused by COVID-19 and a resurgence in global economic activity. Therefore, the purchase price of cathode copper utilized for the financial analysis was USD 8172.14 per ton. This is an average of the prices forecasted by Bloomberg for 2021.

Figure 17. Cathode copper prices, real, USD per ton



Source: World Bank, Bloomberg

Therefore, the annual operating cost of raw material, cathode copper, is USD 49.03 million for a plant with 6000 ton capacity, USD 490.33 million for 60,000 ton capacity, and USD 980.66 million for 120,000 ton capacity. Sensitivity of the project and its profitability to price of cathode copper will be conducted in Section 5.8.

For wages, the research team utilized the average monthly salary of those working in the mining sector, which was approximately MNT 3 million in 2020. Most companies allocated an extra month's allowance at the end of the year as a bonus, therefore, the annual wages of one employee would be MNT 39 million. This value is converted to USD using the exchange rate from 1 July 2021 (2848 MNT/USD). Additionally, social insurance premiums are added onto the wages. According to the General Social Insurance Agency, the social insurance premium will be 12.5 percent, 13.5 percent, or 14.5 percent depending on the level of occupational hazard. These premium rates will come into effect starting from 1 July 2021. As the mining and manufacturing sector is some of the highest risk occupations, the social insurance premium chosen for the financial analysis is 14.5 percent.

As for the number of employees, it will depend on the annual capacity of the plant. Assuming that the continuous casting machine requires 3 person to operate per set and the drawing machine 2 person, the total number of persons working per shift is 5 people. As the machineries need to be operational 24/7, there will be 3 shifts, which totals to 15 people operating the machineries for a 6000 ton capacity. On top of the 15 technical employees, there will be 5 administrative employees, bring the total of employees for a 6000 ton capacity plant to 20. For a 60,000 ton capacity, the research team is assuming that a total of 120 employees will be required and for a 120,000 ton capacity, 240 employees. Based on these assumptions, the annual cost of wages per capacity level is below:

Table 7. Number of employees and annual cost of wage per capacity level

	6,000 tons	60,000 tons	120,000 tons
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Number of employees	20	120	240
Annual cost, USD	USD 0.31 million	USD 1.88 million	USD 3.76 million

Source: researchers' own calculations

Assuming that the plant is operational only 330 days per year, the annual power consumption of a 6000-ton capacity plant is 4.6 kWh. The power consumption is based on the technical specifications of the continuous casting and drawing machines, which were 300 kW and 280 kW, respectively. The power consumption tariffs for factories and plants in Erdenet were MNT 140.59 per kWh for electricity and MNT 23.79 per kWh for additional charges related to power consumption. Therefore, the charge for power consumption is approximately USD 0.06 per kWh. Similar to the operating expense above, the annual power consumption cost would increase as the plant capacity increased. For a plant with 6000 ton capacity, the annual cost of electricity is around USD 0.27 million.

Another operating cost which is included in the financial analysis is transportation cost. According to the Ulaanbaatar Railway, the loading and unloading tariffs are MNT 3000 and MNT 300, respectively, per ton and transportation of 66 tons (the maximum capacity of one wagon) of product from Erdenet, Mongolia to Erenhot, Inner Mongolia is MNT 2.759 million. The cost of loading, unloading, and transporting to Erenhot via railway is approximately USD 15.89 per ton.

Depreciation of the machinery and building is also included within the operating costs of the plant. Depreciation is calculated with the straight-line method in Mongolia with the useful life of machineries being 10 years and building 40 years. The cost of the machinery and building are detailed in the next section.

The total operating expense for a 6000 ton plant is USD 49.8 million, USD 496.44 million for 60,000 ton and USD 992.89 million for 120,000 ton.

4.6. Investment and financing

Another component of the financial analysis is determining how much investment is needed to start the project and the various options to finance it. If the project is not able to be financed through own source, bank loans, soft loans, or other forms of financing, the likelihood of the project succeeding is very low.

4.6.1. Required investment

The requirement investment included within the financial analysis is the bare minimum. In other words, it includes the investment needed to purchase the equipment and the cost of constructing the plant building.

The continuous copper rod casting is very basic. The main components of the equipment are:

- Furnace (melting furnace and holding furnace)
- Copper melting channel and crystallizer
- Continuous casting machine
- Frame of guide pulley

- Limited device
- Double-station coiling machine
- Cooling-water system
- Electric control system
- Charge system
- Thermistor

One set of this equipment is able to produce 6000 tons of copper rods per year. The rod diameters can be changed from 8-30mm. The average cost of the machine is approximately USD 200,000 per set. The second equipment needed is the copper wire drawing machine. The copper wire drawing machine consists of:

- Cantilever payoff stand
- Main drawing machine
- Accumulator
- $\Phi 500$ - $\phi 630$ automatic dual-reel take-up
- Dog mould-piercing mill
- Oil-feeding center of main machine
- Supply center of wire drawing liquid
- Steam generator
- Electric control and operating desk

The copper wires produced can be 1.2-4mm, the maximum speed of drawing is 23 meters per second. The approximate cost of the machine is around USD 180,000.

One set of each of these equipment total to USD 380,000, excluding customs duties and other costs. In addition to the machineries, cost of constructing the building is included in the calculations. A rough estimated amount of USD 1 million is set for the building cost for a 6000 ton capacity plant. Therefore, the total required financing, including customs tariffs of 5 percent on imported machinery, is USD 1.4 million for a 6000 ton capacity plant.

Table 8. Required financing

	6,000 tons	60,000 tons	120,000 tons
Required financing	USD 1.4 million	USD 14.0 million	USD 28.0 million

Source: researchers' own calculations

4.6.2. Financing

In terms of financing, the plant may not be eligible for the soft project loans offered by the Development Bank of Mongolia. The minimum amount that needs to be requested is MNT 20 billion, which is approximately USD 7 million (using the exchange rate of 2850 MNT/USD). Commercial banks offer a 12 percent interest rate 5-year loan for investments. Additionally, through commercial banks, JICA offers 5 percent interest rate 10-year loans for projects.

The impact of the two financing options on the project and its profitability are calculated in the next section. To clarify further, three scenarios are included in the financial analysis in terms of

financing options. First, the project completely financed by own sources; second, a bank loan for investment is used to finance the cost of machineries and building; third, the soft loan offered by JICA is used to finance the purchase of the machinery and construct the building.

4.7. Profitability

The difference between revenue and operating expenses yields the operating profit, or earnings before interest and taxes (EBIT). From EBIT, taxes are deducted to derive the first component of the free cash flow calculation, $EBIT \times (1 - \text{taxes})$. Taxes are relatively straightforward in that the rates are determined by Mongolia's tax regime. In Mongolia, corporate income tax (CIT) is 10 percent for up to the first 6 billion of annual taxable income and 25 percent for any amount in excess of MNT 6 billion. A 10 percent VAT is imposed on supply of goods, services, and works imported, exported, and sold in Mongolia.

In 2010, the Parliament of Mongolia introduced an amendment to the Minerals Law and a new surtax royalty regime came into effect from 1 January 2011. Under the new two-tier system, a surtax royalty is imposed on the total sales value of 23 types of minerals in addition to the standard flat-rate royalty. The surtax royalty rate varies depending on the type of mineral, its market prices and the degree of processing, generally from 0-5 percent of market prices.

Table 9. Royalty surtax rate on copper, %

Future market price (USD/ton)	Ore	Concentrate	Product
0-5000	0	0	0
5000-6000	22	11	1
6000-7000	24	12	2
7000-8000	26	13	3
8000-9000	28	14	4
9000 and above	30	15	5

Source: Article 47 of the Minerals Law of Mongolia

Once profit after taxes is calculated, the free cash flow can be derived:

$$FCFE = EBIT - \text{Taxes} - \text{Interest} + \text{Depreciation} - \text{CAPEX} - \Delta \text{Working Capital} + \text{Net Debt}$$

To derive free cash flow, the equation above is utilized. Tax and depreciation are already calculated. Interest and net debt will depend on the financing methods chosen. Capital expenditure, or CAPEX, is the required financing for the machinery and building and working capital is assumed to be equal to 40 percent of CAPEX. Based on the calculated free cash flow, the NPV, IRR, and payback period of various combination of scenarios are calculated.

Based on estimates and assumption above, the NPV and IRR of a 6000-ton capacity copper fabricating plant with no external financing is USD 2.53 million and 35.5 percent, respectively. The payback period is 3.68 years. As seen in the following tables, the NPV of the plant increases as external financing is introduced or the annual capacity of the plant increase. The most favorable scenario is created with the the low interest rate loan and 120,000 ton annual capacity.

Table 10. Net present value of copper fabricating plant, million USD

NPV, in million USD		Annual capacity (tons)		
		6,000	60,000	120,000
Financing method	None	\$ 2.53	\$ 13.61	\$ 25.27
	Bank loan	\$ 7.11	\$ 59.36	\$ 116.78
	Soft/project loan	\$ 9.36	\$ 81.89	\$ 161.83

Source: researchers' own calculations

However, the payback period of the plant increases as the plant's capacity is expanded. Additionally, with external financing, the payback period of the investment is shortened.

Table 11. Payback period of copper fabricating plant, years

Payback period, years		Annual capacity (tons)		
		6,000	60,000	120,000
Financing method	None	3.68	4.63	4.74
	Bank loan	1.29	1.32	1.32
	Soft/project loan	1.27	1.30	1.30

Source: researchers' own calculations

In terms of comparability to the cost structure of the copper wire manufacturing industry, net income was 1.1 percent of total revenue. According to IBISWorld, profit in the copper wire manufacturing industry was equivalent to around 3 percent of total revenue. Similarly, the net income to total revenue of Aurubis, the largest copper fabricator in Europe, ranged from 0.8-2.4 percent over the past decade.

4.8. Sensitivity Analysis

As mentioned in the previous section, a sensitivity analysis is conducted of the key inputs of the copper fabricating plant. The two main inputs are the selling price of the copper wire and the purchase price of the cathode copper. The base scenario used to test the price sensitivity was of the copper fabricating plant with an annual capacity of 6000 tons and no external financing.

These price sensitivities are conducted with all other estimates and assumption unchanged except for the respective price. In the table below, only the price of copper wire was changed. The price of copper wire was changed to USD 11,000 per ton and starting from USD 10,500 per ton decreasing by USD 100. As seen in the table below, the profitability and payback of the plant improves the higher the price of copper. Copper wire prices below USD 10,200 USD is seen to be unprofitable as the NPV and IRR become negative, and the payback period extends beyond 10 years.

Table 12. Copper wire price sensitivity

	NPV (million USD)	IRR (%)	Payback period (years)
11,000	\$ 18.39	169.1%	1.59

Price of copper wire (USD/ton), including VAT	10,500	\$ 7.15	75.4%	2.32
	10,400	\$ 4.90	56.3%	2.76
	10,300	\$ 2.65	36.6%	3.61
	10,200	\$ 0.40	14.6%	6.10
	10,100	\$ (1.85)	-29.7%	N/A
	10,000	\$ (4.10)	N/A	N/A

Source: researchers' own calculations

In the next analysis of price sensitivity, only the purchasing price of cathode copper is altered. The profitability of the plant improves as the price of cathode copper is lowered. The point of unprofitability is somewhere between USD 8000-9000 per ton as evidenced by the negative NPV. If the purchasing price of cathode copper rises above USD 8000 while the selling price of copper wire is USD 10,295, the plant becomes unprofitable.

Table 13. Cathode copper price sensitivity

		NPV (million USD)	IRR (%)	Payback period (years)
Price of cathode copper (USD/ton)	9,000	\$ (24.16)	N/A	N/A
	8,000	\$ 7.29	76.6%	2.30
	7,500	\$ 24.91	223.3%	1.45
	7,000	\$ 38.74	338.1%	1.30
	5,000	\$ 101.63	860.7%	1.12

Source: researchers' own calculations

Similar to prices, the sensitivity of the plant's profitability could be analyzed with certain policy measures, such as tax cuts. As seen in the table below, if the plant was exempt from the royalty surtax imposed on copper products, the NPV of the plant would increase 7-folds, and if the corporate income tax was lowered from 25 percent to 10%, the profitability of the plant would increase 4.6 times. If the tax exemption on royalty and tax cut on corporate income tax was both imposed, the profitability of the plant would increase 10-folds.

Table 14. Impact of tax exemptions and cuts on profitability

	Base	Without royalty surtax	10% CIT	Without royalty surtax and 10% CIT
NPV (million USD)	2.53	17.71	11.65	26.83
IRR (%)	35.5	163.4	113.0	239.2
Payback period (years)	3.68	1.61	1.88	1.42

Source: researchers' own calculations

These tax incentives could assist in the establishment of a copper fabricating plant since the profit margins are low.

Some of the main risks associated with the construction of a downstream plant are:

1. Prices of copper wires

2. Prices of raw materials
3. Taxation
4. Infrastructure costs
5. Financing costs

As seen by the financial calculations, the plant can be profitable under the right circumstances and conditions. Primarily, low operating cost and high selling prices. Additionally, the payback period of the initial investment is relatively fast with the appropriate conditions.

Second, as the government has a stake in both EMC and Oyu Tolgoi, one can assume that, if necessary, the government could make EMC or a potential government-owned smelter sign an agreement to provide the copper wire manufacturing plant with raw materials at a stable price. The agreement could ensure price stability and predictable sources of revenue for the smelter and stable purchasing prices for the copper wire plant, thereby, ensuring the stable development of the downstream plant.

Thirdly, similarly to the Dornogobi Sainshand refinery, a special legislation can be administered to control overall taxation issue, including customs taxes, VAT taxes and corporate income taxes, as well as royalties, to promote the downstream plant. It should be noted that even without special taxation regime, the plant can be profitable.

Fourth, the costs of infrastructure can be high as was the case for the Achit Ikh plant; however, if the Erdenet industrial zone is chosen, the additional costs are minimized because the Erdenet already has railways, energy, water resources and roads.

Fifth, lower interest rate certainly makes the plant more profitable. Therefore, it is in government's interest to either use DBM's soft loans or engage in unilateral negotiations to obtain development financing with lower interest rate for the plant. That would be the best case for the project and certainly would reduce risks.

In addition there are technological risks, related with the equipment and its maintenance, management risks and policy risks, inherent for any large investment. However, with the appropriate policy set, those risks can be alleviated.

5. Conclusions and policy recommendations

Mongolia has slowly begun developing its downstream industry as it gradually enters the focus of policies. This is contrary to a few years ago, when most policy developments concerned the development of the mining sector. Additionally, the environment for the development of the downstream industry has been improving since 2008. The general conditions for both private ownership and state-owned downstream industry has been improving.

For **state-owned enterprises**, high economic growth has improved macroeconomic foundations for further investment and growth through:

- **Larger GDP and higher budget revenue**, which allowed for more government financing for infrastructure building in the mining and downstream industries (see the case of the Sainshand refinery, construction of railways and roads)
- **Lower interest rate for sovereign bonds** which also helped to finance economic development projects through the budget and DBM financing (the DBM financed projects)
- **Ability to borrow more funds** through multilateral and unilateral channels to finance downstream industry (see the case for the India-related loan for the Sainshand refinery)
- **A new model of state owned or state-led downstream plant development** as shown by the Sainsand refinery case, which involves unilateral negotiations, sovereign borrowing for the industrial project, creation of appropriate legal environment
- **Creation of Erdenes MGL as an umbrella for coordinating** mines, their excavation, creation of infrastructure and, finally, creation of the downstream industries to overcome coordination and financing issues

2.2. For private industries:

- More capable and **larger private banking system**, which started to finance creation of private downstream plants
- Better ability to attract domestic private capital and FDI investment through **the investment stability agreements**

Both the private and public sector have benefited from the availability of funds from the DBM, banking sector, and stock exchange. Additionally, the skilled labor pool has improved substantially since the introduction of the mining sector. The following conditions observed over the past decade have also contributed to the favorable environment created for investment into the downstream industry:

- Generally better understanding of the complexities and global character of mining and downstream projects,
- More experience of dealing with large private investment projects, both positive and negative consequences of them,
- The understanding that large mining and downstream projects require utmost attention in planning, contracting and management, the necessity to harmonize varying and sometimes contradicting interests of the actors (foreign companies, local communities, government agencies)

- The understanding that nurturing downstream industries requires special legal attention (that is, approval of the specialized laws, which promote certain industries)

However, there also exists some unfavorable conditions or obstacles to the development of the downstream industry:

- The current growth of the economy needs stronger efforts in diversification of exports and mining to become more sustainable, less risky and depend less on geopolitical factors, so far the diversification is not really proceeding and the specialization of the country in few mineral products is actually deepening.
- Creation of the downstream industries needs more human resources and experience for management of the downstream industries and there are higher infrastructure requirements for downstream industry than for the mining itself.
- The necessity for better coordination of the various actors in creation of the downstream industries is still very much on agenda and, so far, institutionally there is not an appropriate solution for policy coordination for creation of downstream industries (like Japan's MITI in the post war period) even despite the increasing understanding of the importance of economic planning in general.
- The financing needs for general economic and social development still are enormous; this greatly limits the possibilities for the investment in the downstream industries
- The inability to focus on specific projects or the failure to complete the projects with private investors due to conflicts among politicians, agencies and other related parties (thus the necessity for "the social contract").

Based on these conditions and analysis, the following policy recommendations are developed for the further development of state-owned enterprises:

- The need to create more focused approach on the downstream plants, which involves all related products, makes responsibilities of related agencies clear and clarifies the leading roles of various ministries
- Need for better management and transparency of the SOE to manage the downstream projects

For the private and public sector, the general policy needs are lower interest rates, more available public infrastructure for downstream projects, government subsidies or taxation incentives. Therefore, the recommendations are

1. Create and approve specialized legislation for ferrous and non-ferrous metallurgy, which contain taxation incentives for both private and state-owned investors in the field.
2. Narrow the Erdenes MGL activities towards steel and copper processing and provide them with the government guarantees
3. Initiate unilateral negotiations on tied grants and loans for the steel and copper plants.
4. Aim education efforts towards management of downstream processing plants and training of engineering personnel in ferrous and non-ferrous metallurgy
5. Intensify public investment in infrastructure for the industrial zones.

With these steps, the progress in metallurgy should be faster and the policy goals will be clearer. After 10 years of development of mining, the country is progressing towards the next stage of downstream processing of minerals, so the legislation and policies towards the heavy industry should be now updated and become more concrete and offer more significant incentives towards the investment in the processing industry.

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7. Appendix

The SUMZ plant's statement of losses and income is as follows in Russian rubles:

Income statement					
Fiscal Year January-December. All Values are in RUB Millions	2014	2015	2016	2017	2018
Sales/Revenue	12,084	17,958	18,762	22,788	40,868
Sales Growth	-	48.60%	4.48%	21.46%	79.34%
Cost of Goods Sold (COGS) incl. D&A	7,832	9,584	10,407	15,882	34,336
COGS Growth	-	22.38%	8.59%	52.61%	116.20%
COGS excluding D&A	6,365	8,370	9,216	14,720	33,202
Depreciation & Amortization Expense	1,467	1,214	1,191	1,163	1,134
Depreciation	0	0	0	0	0
Amortization of Intangibles	0	0	0	0	0
Gross Income	4,253	8,374	8,355	6,905	6,532
Gross Income Growth	-	96.89%	-0.23%	-17.35%	-5.40%
Gross Profit Margin	-	-	-	-	15.98%
SG&A Expense	3,206	3,644	3,697	3,882	3,842
SGA Growth	-	13.67%	1.46%	5.01%	-1.02%
Research & Development	3	1	1	0	0
Other SG&A	3,202	3,643	3,696	3,882	3,842
Other Operating Expense	0	0	0	0	210
Unusual Expense	0	0	0	0	0
Non Operating Income/Expense	-7,152	-2,866	881	-1,289	-2,689
Non-Operating Interest Income	43	46	107	61	146
Equity in Affiliates (Pretax)	0	0	0	0	0
Interest Expense	445	1,332	2,031	1,666	1,816
Interest Expense Growth	-	199.30%	52.44%	-17.96%	8.98%
Gross Interest Expense	468	1,345	2,031	1,738	1,837
Interest Capitalized	23	13	0	72	21
Pretax Income	-6,507	578	3,615	130	-1,879
Pretax Income Growth	-	108.90%	525.60%	-96.40%	-1543%
Pretax Margin	-	-	-	-	-4.60%
Income Tax	0	0	0	0	0
Income Tax - Current Domestic	1	1	1	97	()
Income Tax - Current Foreign	0	0	0	0	0
Income Tax - Deferred Domestic	-1,207	150	857	120	-177
Income Tax - Deferred Foreign	0	0	0	0	0
Income Tax Credits	0	0	0	0	0
Equity in Affiliates	0	0	0	0	0
Other After Tax Income (Expense)	0	0	0	0	0
Consolidated Net Income	-5,300	427	2,757	-87	-1,702
Minority Interest Expense	0	1	0	0	0
Net Income	-5,301	426	2,757	-87	-1,702
Net Income Growth	-	108%	546.30%	103.20%	-1853%
Net Margin Growth	-	-	-	-	-4.17%
Extraordinary & Discontinued Operations	139	1	0	0	0
Extra Items & Gain/Loss Sale Of	0	0	0	0	0
Assets	0	0	0	0	0
Cumulative Effect - Accounting Chg	0	0	0	0	0
Discontinued Operations	139	1	0	0	0
Net Income After Extraordinaries	-5,161	427	2,757	-87	-1,702
Preferred Dividends	0	0	0	0	0
Net Income Available to Common	-5,161	427	2,757	-87	-1,702
EPS (Basic)	-511	42	273	-9	-168.52
EPS (Basic) Growth	-	108.20%	550%	103.30%	-1772%

Basic Shares Outstanding	10	10	10	10	10
EPS (Diluted)	-511	42	273	-9	-168.52
EPS (Diluted) Growth	-	108.20%	550%	-103.30%	-1772%
Diluted Shares Outstanding	10	10	10	10	10
EBITDA	2,514	5,944	5,849	4,186	3,614
EBITDA Growth	-	136.40%	-1.59%	-28.43%	-13.66%
EBITDA Margin	-	-	-	-	8.84%

The balance sheet is as follows:

Assets					
Fiscal Year January-December. All Values are in RUB Millions	2014	2015	2016	2017	2018
Cash & Short Term Investments	54	173	1,554	451	1,266
Cash & Short Term Investments Growth	-	220.10%	800.80%	-71%	180.90%
Cash & ST Investments / Total Assets	0.33%	0.97%	7.14%	1.65%	3.39%
Cash Only	54	173	1,554	451	1,266
Short-Term Investments	0	0	0	0	0
Total Accounts Receivable	2,561	4,039	7,007	9,943	8,341
Accounts Receivable Growth	-	57.72%	73.48%	41.91%	-16.11%
Accounts Receivable Turnover	4.72	4.45	2.68	2.29	4.9
Accounts Receivables, Net	1,785	978	3,133	4,890	3,037
Accounts Receivable, Gross	1,788	987	3,148	4,899	3,058
Bad Debt/Doubtful Accounts	-3	-9	-15	-9	-21
Other Receivables	776	3,061	3,874	5,053	5,305
Inventories	2,073	2,502	2,979	6,450	6,868
Finished Goods	2	1	266	796	41
Work in Progress	1,009	1,303	1,333	4,208	5,376
Raw Materials	1,063	1,198	1,380	1,445	440
Progress Payments & Other	0	0	0	0	1,012
Other Current Assets	174	153	216	1,196	3,406
Miscellaneous Current Assets	0	0	0	1,196	3,406
Total Current Assets	4,862	6,866	11,756	18,040	19,881
Fiscal Year January-December. All Values are in RUB Millions	2014	2015	2016	2017	2018
Net Property, Plant & Equipment	9,872	9,419	9,231	8,975	8,608
Property, Plant & Equipment Gross	17,698	18,308	19,247	19,797	20,511
Buildings	6,374	6,320	6,767	6,925	6,978
Land & Improvements	0	0	0	0	0
Computer Software and Equipment	0	0	0	0	0
Other Property, Plant & Equipment	374	377	390	393	410
Accumulated Depreciation	7,826	8,889	10,016	10,822	11,903
Total Investments and Advances	21	22	0	0	0
Other Long-Term Investments	21	22	0	0	0
Long-Term Note Receivable	346	387	433	4	8,416
Intangible Assets	18	17	13	12	13
Net Goodwill	0	0	0	0	0
Net Other Intangibles	18	17	13	12	13
Other Assets	0	0	0	0	22
Tangible Other Assets	0	0	0	0	22
Total Assets	16,482	17,887	21,766	27,252	37,303
Assets - Total - Growth	-	8.52%	21.69%	25.20%	36.88%
Liabilities & Shareholders' Equity					
Fiscal Year January-December. All Values are in RUB Millions	2014	2015	2016	2017	2018

ST Debt & Current Portion LT Debt	15,931	10,633	1,578	17,353	21,143
Short Term Debt	15,931	10,633	1,578	17,353	21,143
Current Portion of Long Term Debt	0	0	0	0	0
Accounts Payable	550	913	1,124	1,241	1,581
Accounts Payable Growth	-	66%	23.04%	10.46%	27.31%
Income Tax Payable	0	0	0	64	0
Other Current Liabilities	493	482	730	589	696
Dividends Payable	0	0	0	0	0
Accrued Payroll	0	0	0	139	133
Miscellaneous Current Liabilities	493	482	730	450	562
Total Current Liabilities	16,975	12,029	3,431	19,247	23,420
Long-Term Debt	360	6,323	16,032	5,783	13,417
Long-Term Debt excl. Capitalized Leases	360	6,323	16,032	5,783	13,417
Non-Convertible Debt	360	6,323	16,032	5,783	13,417
Convertible Debt	0	0	0	0	0
Capitalized Lease Obligations	0	0	0	0	0
Provision for Risks & Charges	25	23	20	17	13
Deferred Taxes	-1,022	-873	-16	104	-76
Deferred Taxes - Credit	341	302	317	326	288
Deferred Taxes - Debit	1,363	1,175	333	221	364
Other Liabilities	0	0	0	0	0
Other Liabilities (excl. Deferred Income)	0	0	0	0	0
Deferred Income	0	0	0	0	0
Total Liabilities	17,701	18,677	19,800	25,373	37,138
Total Liabilities / Total Assets	107.40%	104.40%	90.97%	93.11%	99.56%
Non-Equity Reserves	0	0	0	0	0
Preferred Stock (Carrying Value)	0	0	0	0	0
Redeemable Preferred Stock	0	0	0	0	0
Non-Redeemable Preferred Stock	0	0	0	0	0
Common Equity (Total)	-1,218	-790	1,966	1,879	165
Common Equity / Total Assets	-7.39%	-4.42%	9.03%	6.90%	0.44%
Common Stock Par/Carry Value	1	1	1	1	1
Retained Earnings	-3,723	-3,296	-539	-626	-2,340
ESOP Debt Guarantee	0	0	0	0	0
Cumulative Translation Adjustment/Unrealized For. Exch. Gain	0	0	0	0	0
Unrealized Gain/Loss Marketable Securities	0	0	0	0	0
Revaluation Reserves	0	0	0	0	0
Treasury Stock	0	0	0	0	0
Total Shareholders' Equity	-1,218	-790	1,966	1,879	165
Total Shareholders' Equity / Total Assets	-7.39%	-4.42%	9.03%	6.90%	0.44%
Accumulated Minority Interest	-1	0	0	0	0
Total Equity	-1,219	-790	1,966	1,879	165
Liabilities & Shareholders' Equity	16,482	17,887	21,766	27,252	37,303

And, finally, its cash flow is as follows:

Fiscal Year January-December. All Values are in RUB Millions	2014	2015	2016	2017	2018
Net Income Before Extraordinaries	-5,161	427	2,757	0	0
Net Income Growth	-	108.30%	544.90%		-
Depreciation, Depletion & Amortization	0	0	0	0	0
Depreciation & Depletion	0	0	0	0	0
Amortization of Intangible Assets	0	0	0	0	0
Deferred Taxes & Investment Tax Credit	0	0	0	0	0
Deferred Taxes	0	0	0	0	0

Investment Tax Credit					
Other Funds	6,238	4,768	-1,289	0	-40
Funds from Operations	1,076	5,196	1,468	-4,730	55
Extraordinaries	0	0	0	0	0
Changes in Working Capital	0	0	0	0	0
Receivables	0	0	0	0	0
Accounts Payable	0	0	0	0	0
Other Assets/Liabilities	0	0	0	0	0
Net Operating Cash Flow	1,076	5,196	1,468	-4,730	55
Net Operating Cash Flow Growth	-	382.80%	-71.75%	-422.20%	101.20%
Net Operating Cash Flow / Sales	8.91%	28.93%	7.82%	-20.76%	0.14%
Investing Activities					
Fiscal Year January-December. All Values are in RUB Millions	2014	2015	2016	2017	2018
Capital Expenditures	-646	-521	-727	-1,038	-764
Capital Expenditures Growth	-	19.29%	-39.58%	-42.67%	26.34%
Capital Expenditures (Fixed Assets)	-646	-521	-727	-1,038	-764
Capital Expenditures (Other Assets)	0	0	0	0	0
Net Assets from Acquisitions	0	0	0	0	0
Sales of Fixed Assets & Businesses	3	5	18	27	14
Purchase/Sale of Investments	1,487	0	0	()	0
Purchase of Investments	0	0	0	()	0
Sale/Maturity of Investments	1,487	0	0	0	0
Other Uses	-4	-2,504	-1,003	-2	-7,432
Other Sources	0	134	7	6	3
Net Investing Cash Flow	841	-2,886	-1,706	-1,007	-8,180
Net Investing Cash Flow Growth	-	-443.30%	40.90%	40.97%	-712.40%
Net Investing Cash Flow / Sales	6.96%	-16.07%	-9.09%	-4.42%	-20.01%
Financing Activities					
Fiscal Year January-December. All Values are in RUB Millions	2014	2015	2016	2017	2018
Cash Dividends Paid - Total	0	0	0	0	0
Common Dividends	0	0	0	0	0
Preferred Dividends	0	0	0	0	0
Changes in Capital Stock	0	0	0	0	()
Repurchase of Common & Preferred Stk.	0	0	0	0	()
Sales of Common & Preferred Stock	0	0	0	0	0
Proceeds from Stock Options	0	0	0	0	0
Other Proceeds from Sale of Stock	0	0	0	0	0
Issuance/Reduction of Debt, Net	-1,959	-2,033	1,627	4,713	-32,536
Change in Current Debt	0	0	0	0	0
Change in Long-Term Debt	-1,959	-2,033	1,627	4,713	0
Issuance of Long-Term Debt	3,834	22,771	13,250	11,835	0
Reduction in Long-Term Debt	-5,794	-24,804	-11,623	-7,122	0
Other Funds	0	0	0	-17	41,387
Other Uses	0	0	0	-17	-19
Other Sources	0	0	0	0	41,406
Net Financing Cash Flow	-1,959	-2,033	1,627	4,696	8,851
Net Financing Cash Flow Growth	-	-3.75%	180%	188.60%	88.48%
Net Financing Cash Flow / Sales	-16.21%	-11.32%	8.67%	20.61%	21.66%
Exchange Rate Effect	16	-158	-8	-62	88
Miscellaneous Funds	0	0	0	0	0
Net Change in Cash	-26	119	1,382	-1,103	815
Free Cash Flow	431	4,675	741	-5,768	-709
Free Cash Flow Growth	-	985.60%	-84.16%	-878.80%	87.71%